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BRIEFLY TOLD.

OBITUARY NOTE, CHARLES A. BENNETT, JR.—Last week we were compelled to announce the sudden death of Mr. Charles A. Bennett, Jr., General Manager of the Freehold (N. J.) Gas Light Company, whose decease occurrred on the 24th July, at his home in Freehold. Conformably to our promise of a week ago we append the following sketch of his life and labors: Charles A. Bennett, Jr., who was the son of ex Judge Charles A. Bennett, was born in Freehold, Monmouth county, N. J., on May 8th, 1856. His first tuition was acquired in the Freehold Institute, graduating therefrom in 1873. In September of that year he entered Princeton College, but subsequently electing to engage in a business career he completed a theoretical business course at the Poughkeepsie (N.Y.) Business College, returning home to assist his father in the management of the Freehold gas works. Such duties did not interfere with his desire to study law, the theory and practice of which he acquired in the office of and under the tutelage of his father. In 1878 he was admitted to the New Jersey bar as an attorney, and in 1881 he was licensed to practice as a counsellor. Bright, energetic and ambitious, his success was pronounced and rapid. In 1885 the trade of the Freehold Gas Company had increased to the point of requiring the entire time for its direction of a man well versed in business ways, and the subject of this sketch then assumed complete control of its management. Successful in this as in other things, he carried the Company on to prosperity, and the Company has the distinction of selling at least as much gas per capita per annum as any other Company in the State—the population of Freehold is something less than 3,000, and the gas sendout there is perhaps 5,500,000 cubic feet. The Company operates an electric lighting annex, too, which was also managed by deceased. He was elected to active membership in the American Gas Light Association at the meeting held in this city, October, 1891, and since his affiliation therewith did not fail to respond to roll call at any of its meetings. He was also a frequent visitor to the meetings of the Western and the New England Associations, nor need we say that no more welcome guest was received by them, for Bennett had that charm of manner and straightforward personality which attract and retain friendship to the end. He was Assistant Secretary of the Monmouth County Mutual Fire Insurance Company; Secretary of the Mutual Life Insurance Company; and Secretary of the Goodwill Hook and Ladder Company, of the Freehold Fire Department. He was a prominent member of Olive Branch Lodge, F. and A. M., and was a valued member of the Lotus Club, of this city, where his cheery presence was felt even amidst that brilliant aggregation of last of the century men. He was united in marriage, on September 6, 1877, to Miss Clara James, of this city, who survives him. The funeral services were celebrated at the residence of his father, Main street, Freehold, on the afternoon of Saturday, July 27, the Reverend Mr. W. E. Wright, of the Episcopal Church, officiating. A gathering truly representative of Freehold's citizenship assisted in the mournful services, and in the throng were Mr. William W. Goodwin, of Philadelphia, and Mr. S. F. Hayward and Mr. C. E. Sanderson, of this city. The interment was made in Maplewood Cemetery, the impressive services at the grave being conducted according to the Masonic ritual, by the Rev. Mr. Wright, who is Chaplain of Olive Branch Lodge. In closing this brief sketch of the life of Mr. Bennett, we wish to here bear honest testimony to our feeling of personal loss over the demise of a friend whose lovable character, staunchness of purpose and all-round merit formed the keystone that bound him to the hearts of those who shared his companionship.

DEATH OF MR. E. S. FUNNELL.—Another member of the fraternity to join the majority was Mr. Ebenezer S. Funnell, who died at his home in Albany, N. Y., on Saturday, July 27. Deceased, who was in his 67th year, was for a long time connected with the firm of Messrs. D. McDonald & Co., of Albany, as their travelling man. He was a charter member of the Ohio Association, which organization subsequently elected him to honorary membership. He was much esteemed. The funeral services were celebrated at his late residence on the afternoon of Tuesday last.

THREE READABLE PAPERS.—Our current number contains the continuation of our official report of the proceedings of the Third Annual Meeting of the Pacific Coast Gas Association, and there cannot be any doubt about it that those who read the matter will agree with us that the contributors to the paper list of the Pacific's convention were quite up to their obligations. Perhaps the paper by Mr. Howard on "Welsh Anthracite Coal" might be open to the charge that the author engaged somewhat in special pleading for Welsh anthracite; but it must be remembered that the fuel question on the Coast is certainly a "burning one," and the elements of economy, everything considered, are more than important in the land bordering the Pacific. The discussion, however, put Welsh anthracite somewhat in the rear, in any event in those places where the screenings reached the comfortable total of 35 to 60 per cent. As a whole, the paper was well put together, and Mr. Howard, we hope, will be heard from again. The pleasant surprise of the first day was the paper by Mr. J. B. Grimwood, on "Technical Gas Analysis," who gave out a thesis that we venture to say will often be referred to by many a gas man when on analysis bent. It is a scholarly production; without a defect, its value is equally perfect. Mr. John Clements wrote entertainingly on "The Economy of Small Works," and although its title is somewhat of a misnomer, nevertheless he gave many true examples of the good that results from the maintenance of a vigilant eye in watching over small works in respect of their internal administration. We are sure, anyway, that all three papers are interesting—and that is sufficient.

SOME SPECIAL CORRESPONDENCE.—A "Man from Boston" relates the following narrative anent a recent doing of the Guild:

BOSTON, MASS., July 26th, 1895.

Dear JOURNAL: At the meeting of the Guild of Gas Managers, held prior to July 20th, the members received an invitation to hold their next session at Kineo Cottage, Point Shirley, Winthrop, Mass., from Mr. William Anderson, Supt. of the East Boston Gas Company, Mr. C. M. Coburn, Manager of the Liberty Oil Company, of Boston, joining in the request. The Guild also received an invitation from Mr. Thomas Hintze, Supt. of the Chelsea Gas Light Company, to visit his works while en route to Kineo Cottage. The invitations were accepted by the Guild, the members all voting to hold their next meeting at Mr. Anderson's summer home. On July 20th the members, to the number of about 30, took a "boat barge," drawn by four handsome gray horses, richly caparisoned, and driven by their owner (Capt.-Gen. Joseph White, of Chelsea), from the premises of Waldo Brothers, 88 Water street, Boston. Crossing from Boston to Chelsea by ferryboat, which meant a delightful 10-minute trip, the party invaded the Chelsea gas works, where for so many years our beloved and esteemed associate (the late John Andrew) held the fort. We were met by the genial Hintze, who showed us about the works, after which we were invited to demolish a splendid luncheon, for which Mr. Hintze was responsible—it is needless to say it was demolished. Fortified with cigars, we re-entered the barge and were driven to the East Boston gas works. After a short stop there we started for Kineo Cottage. By this time the fun began, and the climax was reached when the irrepressible "Cy.," espying an Italian street band, stopped the barge and engaged the "musicians" for the rest of the day. We reached Kineo Cottage about 1 P.M., and were welcomed by the estimable wives of Messrs. A. and C., only to be given full control of the house and grounds. The fun was now in full blast. Each seemed to vie with the other to determine who could enjoy himself the most. The "band" was placed on the porch, where songs, jigs and speeches were indulged in; meanwhile "Bill," the "brother of the fellow who butted the bull off the bridge," and "Cy.," were busy carting on the steamed clams, lobster salad, cold meats, and other good things—of which there looked to be no end. The bountiful collation over, the "boys" amused themselves trying to pitch quoits, to play ball, etc. Later on, much to their surprise, Mr. A. J. Waldo and his genial partner came upon the scene and invited the Guild, when on their return, to tarry a while at their beautiful highland home on Winthrop Highlands. Of course the invitation was accepted, and about 4:30 P.M. we were en route to Summit Cottage, in a barge furnished by Mr. W. We were entertained with charming hospitality. A light collation was put away, cigars were again lighted, and a general good time was on. There was no lack of music, for Mr. and Mrs. W. had provided a musical treat for the boys—which was in addition to that already provided by the irrepressible "Cy." At about 6:30 P.M. the "boys" hustled to get their train, after voting hearty good wishes to their host and hostess. It is unnecessary to state that all the old-timers were present—there were also others. I was pleased myself, and thought you would be pleased to have a word about our trip, and to know that we still live.

"Where are you Hat?" DAN.

[OFFICIAL REPORT—Continued from page 170.]

THIRD ANNUAL MEETING OF THE PACIFIC COAST GAS ASSOCIATION.

HELD IN SAN FRANCISCO, CAL., JULY 16 AND 17, 1895.

FIRST DAY—MORNING SESSION.

REPORT OF THE SECRETARY-TREASURER.

The Secretary and Treasurer (Mr. Jno. A. Britton) read the following annual report:

To the President and Board of Directors, Pacific Coast Gas Association—Gentlemen: I have the honor to present herewith my second annual report as Secretary and Treasurer:

Membership enrolled, May 15th, 1895		56
Admitted to membership " "		20
Total enrollment		76
Deceased during year (Messrs. Eastland and Elmore)	2	
Resigned (M. M. Barrett)	1	3
Net enrollment to date		73

The following applications for membership have been received:

D. E. Knight, President Marysville Coal Gas Co.
H. J. Lewelling, President St. Helena Gas Co.
G. H. Taylor, Superintendent Chico Gas Co.
John L. Howard, Manager Oregon Improvement Co.
Geo. Keaton, Lessee Gilroy Gas Light Co.
L. F. Fogg, Secretary Bay City Iron Works, San Francisco.
E. P. Callender, AMERICAN GAS LIGHT JOURNAL, New York.
W. W. Gillespie, Secretary San Jose Light and Power Co.

Cash on hand, as per report May 15th		$368.60
Collections.		
Dues	$320.00	
Initiation	100.00	420.00
		$788.60
Expenses.		
Voucher 7—Armstrong & De Guerre	$38.60	
" 8—J. A. Britton	10.00	
" 9—*Enquirer* Publishing Co	7.25	
" 10—B. U. Steinmann	18.50	
" 11—T. R. Knox	130.80	
" 12—L. Faure	255.45	
" 13—J. A. Britton	6.55	
" 14—J. A. Britton	6.40	
" 15—Carruth & Carruth	1.00	
" 16—J. A. Britton	29.50	$504.05
		$284.55
Cash on hand		$284.55
Dues from members:		
Back dues		95.00
Initiations		25.00
Present dues		360.00
Cash available		$764.55
Probable expenses:		
Banquet		$300.00
Printing		50.00
Music		15.00
Stationery, etc		15.00
		$380.00

Respectfully submitted,
(Signed). JOHN A. BRITTON, Secretary.

REPORT OF THE BOARD OF DIRECTORS.

The report of the Directors, approving the report of the Secretary-Treasurer, and reporting favorably upon the election to membership of the applicants therein named, was read as follows:

Pacific Coast Gas Association—Your Board of Directors beg leave to report that, acting under Article 8 of the by-laws, they have examined the accounts of the Secretary and Treasurer and all vouchers presented in connection therewith, and endorsed them as correct.

We also recommend that the following applications for membership be favorably received:

G. H. Taylor, D. E. Knight, Geo. Keating, H. J. Lewelling, John

L. Howard, L. F. Fogg, E. P. Callender, W. W. Gillespie, Walton Clark, J. D. Collins, L. B. St. Clair, Thomas Thompson, H. T. Lally, D. R. Russell, J. B. Grimwood, Andrew Carrigan.

(Signed) C. F. Adams, M. C. Osborn, T. R. Parker, } Directors.

Election of New Members.

Upon motion of Mr. Eichbaum, the Secretary was authorized to cast the ballot of the Association in favor of the election of the applicants named.

On motion of Mr. Eichbaum the report of the Secretary-Treasurer, as approved by the Auditing Committee of the Board of Directors, was received, accepted and placed on file.

Appointment of Committees.

The President—Gentlemen, this Association has lost two of its members during the past year. Mr. Van Leer Eastland, who, as is well known, took a prominent part in the affairs of this Association, and who gained the good will and respect of not only the business men of the community with whom he came in contact, but also with the capitalists and investors in the companies in which he was interested, has been taken from us, and it is proper that a committee be appointed to draft suitable resolutions to his memory. The same remark will apply also to our late member, Mr. M. G. Elmore.

On motion Messrs. John A. Britton, E. C. Jones and T. R. Parker were appointed an Obituary Committee.

Messrs. F. H. Eichbaum, Charles F. Adams and Philip Meyer were appointed to serve as the Committee to Name Next Place of Meeting.

The Committee on Nominations was then appointed as follows: Messrs. Henry E. Adams, M. C. Osborn and J. W. Thomas.

The President—I would like to hear some suggestions as to the Committee on "Wrinkles" for the next meeting.

Mr. Jones—I am familiar with the labor and with the amount of work involved in collecting these wrinkles, and I am sure the members will be exceedingly interested in the result of Mr. Parker's efforts. I would, therefore, like to recommend that Mr. Parker be continued at the head of the "Wrinkle" department during the coming year.

Mr. Britton—I desire to second that motion. I know our friend Parker has been so interested in the work that he would be very much disappointed if anyone else were appointed on that committee.

Mr. Parker—I wish to say that I do not desire to deprive any member of this Association of the pleasure of gathering wrinkles on this Coast.

Mr. Clements—I have been visiting with Mr. Parker, at Napa, and know that the result of his labors will show that he has been in earnest. I know that the letters he has written to members of the Association on the subject will show that he has been hard at work.

Messrs. T. R. Parker and John Clements were then appointed the Committee on "Wrinkles" for the next meeting.

Reading the Papers.

The President then called for the reading of papers, and introduced Mr. John L. Howard, General Manager of the Oregon Improvement Company, who read the following on

WELSH ANTHRACITE COAL.

Artemas Ward had a lecture which he called "The Babes 'n the Wood." At the beginning he announced the title. During the lecture he made no allusion whatever to those ill-starred infants that were supposed to have furnished him with a theme. At the end, he said he knew nothing about the babes himself, and would refer the audience to the story books. I have been asked to read a short paper on anthracite coal from Wales. I have never been in Wales.

It might probably be assumed that in a gathering such as this my paper should make reference to the manufacture of gas from this mineral. I know very little about the process of making either coal or water gas.

If, therefore, you expect anything new or learned from me in respect of the country from which this coal comes, or of its conversion into the commercial product, the making and sale of which is the business and the lifework of so many of you, then my paper from its title will be as misleading as was the subject of Mr. Ward's lecture.

There have always been men pulling at the skirts of Mother Nature, asking questions, and trying to wrest from her the secret of why and how her works came to be as they are.

I have been trying to keep up with the theories of these geologica' people, and perhaps I can do no better at the outset than to state in a concrete way the most recent and accepted statements regarding the origin and formation of fossil fuel.

Under the favorable atmospheric conditions of the coal forming era, the then existing flora attained a dense, rank growth; this died or was destroyed in places, or deposits of it were made by torrent action. The mass was submerged, then buried beneath the sediment deposited during the inundation. Upon this sedimentary soil other plants grew. These were likewise submerged and buried, and so the process went on during unnumbered years, until in places there were built up more than 100 coal seams aggregating 250 feet in thickness, and with their associated rocks, making a total thickness of 13,000 feet.

The coal formations, therefore, are a marvelous geological record of life, death, decay, submergence, burial, and the mysterious transformation of vegetation into coal.

The vegetable origin of coal seems to be proved beyond any reasonable doubt. The clays accompanying the coal beds are filled with plant impressions; the coal itself frequently shows the forms of plants. Moreover, the organic texture of the coal-forming plants is preserved in easily recognizable forms.

This much is certain as to the origin, but as to the mode of accumulation of coal, there is an astonishing difference of opinion among scientific thinkers.

One set called the Bog Theorists, contends that coal was formed where the plants grew. Another set, called the Drift or Estuary theorists, maintains that the deposits are due to stream action, which carried and piled vegetation in immense lagoons or at the mouths of rivers, while a conservative third authority concludes that no one hypothesis is universally applicable, but that growth on the spot and transport from neighboring land, have both, in different regions, contemporaneously and at successive periods, come into play. This middle ground seems reasonable and meets all the peculiar conditions.

What was the condition of the atmosphere during this period of the rank growth of carboniferous vegetation? Here the geological doctors disagree again.

One authority maintains that the climate was warm, moist, uniform, stagnant and stifling, from the abundance of carbonic acid, and unfavorable to the higher forms of animal life.

Another states that in those early times there was no aerial life upon the earth, and so late as the carboniferous period there were only those cold-blooded reptiles whose low order of vital activity corresponded with those conditions of the atmosphere.

Another contends that the amount of carbonic acid in the then atmosphere was not materially greater than now, and that most probably the luxuriance of plant life is rather due to the warm, moist climate, which in carboniferous times appears to have spread over the globe, even into Arctic latitudes.

How long was the carboniferous era?

These same men have theorized even upon this. Taking as working hypothesis the ascertained rate of vegetable deposits in forests, and the rate of sedimentary deposit by rivers, they deduce the result that the formative period of the carboniferous era was from 1,000,000 to 2,500,000 years, but they term these as rough estimates, and they have allowed a liberal margin of safety.

In the minds of ordinary laymen, not accustomed or trained to contemplate these scientific hypotheses or to build theories in explanation of facts, there is some difficulty in comprehending to the fullest extent all the statements of geology respecting fossil fuel.

For example: Vegetable matter has been compressed to the density of coal, and it is found that coal represents in volume about one-eighth of the vegetable material from which it is formed.

I have stood in the anthracite mammoth vein near Pottsville, Penn., 1,300 feet beneath the surface, where the vein, nearly clean and the coal nearly pure, was 30 feet in thickness.

When one is asked to consider that at this point this one of many veins there represents 240 vertical feet of vegetable matter, the tax upon the imagination is severe.

The chief difficulty seems to me to lie in accounting for the homogeneity of the mass. They tell you that this aggregation of moss, leaves, stems, trunks, flowers, seeds and spores was piled up, loosely it must have been, and by compression, heat and chemical charge during successive eras, it became converted into a homogeneous bed of coal.

This solidification has made it seem necessary to establish proof of a plastic, oozy or fluid condition of this vegetable material at some stage in the process. Among the authorities the nearest approach to such a theory is that of Credner, with whose opinion I will close this branch of the subject.

"Coal seams were formed in land-locked basins or lagoons surrounded by wooded swamps in which the decaying vegetation, softening and rotting as it lay on the ground, produced in time a layer of matter of vast thickness.

"The water of frequent rain storms running slowly off in trickling streams, gradually carried with it the softening wood in shreds from inside the incasing rind, which was itself ultimately broken up and conveyed with other deposits into the basin. Here the processes which lead to the formation of coal took the place of decay, the mass of coal being produced from the rind, while the particles of softened wood were converted into fibrous coal.

"The masses of aquatic and marsh plants which covered the surface and margins of the basins with their luxuriant growth also supplied their contingent in the form of the parts which died and sank to the bottom."

This much as to origin and mode of accumulation. We come now to classification.

Coals differ as stars differ, and the differences are due to variations in chemical composition. These differences obtain among coals of the same class, and variations will occur in parts of the same vein. This difference has sometimes been attributed to the greater or less degree of chemical change that has taken place, but a theory is now advanced that the character of coal has been more or less determined by that of the plants from which it has been formed.

Geologists class coals as follows:

Anthracite	90	per cent. to	95	per cent.	fixed carbon.
Semi-anthracite	80	"	85	"	"
Semi-bituminous	15	"	20	"	volatile matter.
Bituminous	30	"	40	"	"
Highly bituminous	50	"	or more		"

Lignite or brown coal.

These divisions are based on determinations of such elasticity that for practical purposes they are not used, and in commerce coals are generalized under two heads, due to the presence of much or of little hydrocarbon gas, the anthracite containing but little (not exceeding 5 per cent.), and other coals, containing more in varying degrees, are called bituminous.

Table of Analyses.

	Anthracite.			Semi-Anthracite.	Bituminous.	Lignite.	Connellsville.	
	Penna.	Welsh.	Tonquin.	Cardiff.	Wallsend	Seattle.	Coal.	Coke.
Moisture	2.50	.76	1.98	1.50	2.52	10.01	1.260	.030
Vol. H C	2.224	5.3	3.06	12.24	30.57	35.12	30.891	.460
Fixed carbon	90.276	92.27	94.01	81.95	61.05	50.12	59.616	89.576
Ash.....	5.000	1.67	.95	4.31	5.86	4.75	8.233	9.934
	100.000	100.00	100.00	100.00	100.00	100.00	100.000	100.000

Respecting anthracite, the theory has been that, in so far at least as concerns the Pennsylvania fields, the rank vegetation of the carboniferous period was formed first into peat beds, and these were changed by pressure, heat and chemical agencies successively into lignites, bituminous, and finally into anthracite coal. This would seem to be logical upon the doctrine that like effects proceed from like causes. Anthracite coal might properly be called natural coke.

If bituminous coal be put into a coke oven and deprived by heat of its volatile hydrocarbons, the result is called artificial coke.

The commercial end in view is the dissipation of the volatile elements and the increase to the highest possible point of the relation of the fixed carbon to the mass.

Thus it will be seen that in Connellsville coal the percentage of fixed carbon was only 60. After its conversion into coke by the driving off of 32 per cent. of volatile matter and moisture, the fixed carbon comprised 60 parts in 68, which raised its percentage to 89.

Compare this now with the analytical determination of a good grade of anthracite from the same Appalachian field in Pennsylvania, and the resemblance in composition will appear to be close, although two substances could scarcely differ more in appearance.

The old theory regarding anthracitism has recently been disputed by Prof. Stevenson, of New York, who holds that anthracite coal has been longer exposed to that kind of decay which takes place in vegetable matter when immersed in water, and consists chiefly in the loss of hydrocarbons, which constitute the volatile elements in bituminous coal. On this supposition the anthracite beds are those which were formed earliest in the swamps, and remained longest devoid of the sedimentary deposits which subsequently preserved them from further change.

Having thus indulged in the theories respecting the origin and accumulation of coal, we remark that the only known deposits of true workable anthracite are in Pennsylvania, Wales, Sonora (Mexico), British Columbia and Tonquin, and the paper will close with what is here known about the Welsh product.

The anthracite deposit in Glamorganshire and Caermarthenshire, in Wales, is embraced within a limited field. Its shipping port is Swansea, and it adjoins the semi-anthracite area which produces the well-known smokeless steam coal so much in demand as fuel for ocean steamers and war vessels. This latter coal takes its name from its shipping port of Cardiff.

The deposit of anthracite has been worked in a small way for more than a generation, but during the past ten years the demand for it in the making of water gas and for domestic and steam use in Great Britain and on the Continent has led to a rapid development of mines in that region.

California is the only one of the United States that receives it, because sailing vessels are attracted here for wheat cargoes, and they bring coal at comparatively low rates to help defray the expenses of the voyage. On the Atlantic seaboard the nearness of the Pennsylvania deposits makes such importations impossible, and, besides, the wheat from there is carried largely by freight steamers, to which coal cargoes with their delays would prove unprofitable. As nearly as I can ascertain, the earliest importation of this coal into California was in 1883, and the gas companies became the first large patrons.

Then came the effort to introduce it for steam generating. It is a refractory coal, and does not readily yield its combustible gases except under the inducement of artificial draught, or with a strong natural draught from high stacks. Much of the product contains iron, and perhaps silica, which under strong heat melts upon the bars and sometimes destroys them. At first it was mixed with a free burning soft coal to promote the combustion and to prevent the adhesion of slag to the bars, but this proving unsatisfactory a combination of a new type of grate bar, with a fan blower making a slight pressure of air (say from ⅛ to ¼ of an inch) in the ash-pit, removed all the objections, with the results:

1. A high evaporative efficiency;
2. Lessening the necessity of frequent cleaning of fires;
3. Cleaner boiler tubes because of the absence of soot;
4. The removal of a very small percentage of ashes;
5. Absolute smokelessness;
6. Independence of variations in atmospheric conditions in respect of draught.

As many of you are engaged in the manufacture of steam, and as by far the largest proportion of coal produced is used for this purpose, it may not be amiss for me to close my paper with some observations based upon my experience with this class of steam fuel.

Steam making is laboratory work on a large commercial scale, the breaking up of a mineral into its gaseous compounds and the mixture of them with the oxygen of the atmosphere to produce heat in order that a fluid may be converted into gas and become the source of power.

Mineral fuel is everywhere an expensive necessity, perhaps nowhere more so than in California, and yet there is probably no other place evidencing a more general ignorance of its proper use than in this State. By ignorance here is meant the lack of appreciation of the wants of fuel, and of its treatment in order that it may yield its best results.

Buyers of fuel too frequently pursue conventional designs of boilers and methods of firing, often employing the cheapest kind of labor to shovel their money value into furnaces, with the thought that economy in construction of plant and in wage rates constitutes permanent economy in cost of operating.

This sin against advanced knowledge carries with it the continuous money punishment of the aggressor, whether the fault lies in thoughtless ignorance or in intentional disregard.

The engineer is not altogether blameless in this matter. He has been confronted with two problems:

First—The cost of manufacturing the steam;

Second—The economical use of it after it has been made.

These are stated in their natural sequence, and yet it can scarcely be denied that the engineer has devoted his talent and enery to the second largely to the neglect of the first, because probably the engine and its accessories have offered the more inviting field for the exercise of inventive and adoptive skill, because the operations in the manufacture of steam are not so visible, and because the principles of chemistry play as important a part as do those of mechanics. The result is that the development of the steam engine has far surpassed that of the steam boiler.

It is true that boilers have been built to work under a pressure of 175

pounds and more per square inch, and that the consumption of coal per horse power per hour has been reduced from 5 and 6 pounds to 1.5 pounds of coal, but this is largely due to the use of high initial steam expanded in the cylinders. There has been no such marked increase in the capacity of the boiler to convert water into effective steam per pound of fuel.

The measure of value of a fuel is its power to evaporate water into steam. Other things being equal, a pound of that fuel is the best and most economical which will turn into steam the greatest number of pounds of water.

Laboratory determinations, if correctly made, are valuable in the formation of judgment by comparing analyses with that of a standard coal well known commercially, but laboratory results are rarely realized in mercantile experience.

The standard commercial method of testing fuels consists in the burning of them under a boiler for ten consecutive hours, accurately weighing the coal consumed and the water fed, and at the end of the test leaving the conditions as to the state of the fire, the pressure of steam and the height of water in the boiler as at the beginning. The pounds of water used are divided by the pounds of coal consumed, the average temperature of feed water is taken, and the result or the evaporation per pound of coal burned is computed on the basis of 212° heat of feed water.

Coals marketed in California vary in evaporative power from 5 to 11½ pounds of water per pound of coal.

Briefly, this is what takes place in the process of combustion: Given a fire, a fresh charge of bituminous coal is added, the volatile hydrocarbon gases are the first to leave the coal, the volume is generated so quickly that it is not supplied with the necessary amount of oxygen from the atmosphere for its complete combustion, hence dense volumes of smoke and waste of heat due to imperfect combustion. The volume and the density of smoke diminish as the volatile gases burn off, and the fixed carbon remains practically inert until the volatile gases cease absorbing the incoming oxygen. The whole operation is practically the manufacture of carbonic oxide, and its admixture with such an exact equivalent of oxygen as will convert it into carbonic acid gas. Perfect combustion, therefore, is the supplying of inflammable gases in the furnace with an exact quantity of oxygen.

Inasmuch as the volume of gas cannot be controlled in the manufacture, men must turn, as they are doing, to the control of the amount of air administered. This cannot be successfully done by any system of natural draft. There are devices attachable to furnaces that practically prevent the formation of smoke, and the time will come, in sorrow it must be said it will come slowly to us through the meshes of municipal politics, when city ordinances will compel either the use of smokeless fuel, or of apparatus for the prevention of smoke from bituminous coal. There is no longer any excuse for a smoke and soot laden atmosphere, and the construction of high expensive chimneys is largely a useless cost.

In practice, however, it is found that the power of fuel is enhanced by *forcing* air beneath the fire instead of *drawing* it through by chimney draught, and this is now capable of such automatic regulation that the steam pressure will scarcely vary from a fixed point, the temperature of the escaping gas can be regulated to almost any point required for the proper utilization of the heat, and it should contain very little else than carbonic acid gas and nitrogen.

The introduction of Welsh anthracite coal for steam generating has been attended with labor, vexations and expense.

Engine drivers and buyers have been found who are still imbued with ideas imbibed in the fall of '49 and the spring of '50.

They are satisfied with the fuel they have been in the habit of using. They do not relish innovations that smack of what they call scientific experiments, but within the past two or three years, after seeing what economy and comfort have been found by their neighbors, and by dint of guaranteed demonstrations to them, steam fuel buyers have been leaving the bituminous and taking up with the anthracite coals.

This demand has reached such a point that the tonnage now listed to bring this class of coal to San Francisco will exceed 150,000 tons of capacity, and by reason of the recently favorable grain freights the price of anthracite has fallen to a figure that has been heretofore thought impossible.

It is entirely safe to say that, taking the evaportive power and cost, no steam making fuel offered in this market is at present comparable with Welsh anthracite coal.

By reason of the fact that it pays no customs duty it can be sold at the price of the best imported bituminous coals, while at the same time its evaporative power is greater by 25 per cent. or more.

But some one may ask, Does not the increasing petroleum product of the oil-fields of Southern California and Peru promise to become the economical fuel in this market? I answer, under certain conditions, yes; and under others, no. It is the question of how much water can be turned into steam for one dollar's cost of fuel.

The most reliable results that have yet been obtained with petroleum as a fuel were those trials at the San Francisco Midwinter Fair, under Heine boilers, where the evaporation was found to be 14.2 pounds of water per pound of fuel, from and at 212° of feed water temperature.

Deducting nothing for the steam used in vaporizing the oil, the oil so used weighed 7.3 pounds per gallon, which is equal to 7.3 barrels per long ton, and at $1.50 per gallon, the cost is $10.95 per ton.

Upon the basis of these figures, one dollar's worth of oil fuel evaporated 2,905 pounds of water.

These same Heine boilers have since been transplanted and fired with Welsh anthracite coal, under an induced draught, with an easy result of 11.5 pounds of water per pound of fuel, and this result has been attained at other places.

Upon the basis of $6 per ton for Welsh anthracite, one dollar's worth of coal will evaporate 4,293 pounds of water, showing, as compared with oil at $1.50 per barrel, a difference of over 46 per cent. in favor of coal, or, in other words, oil must approach a cost of $1 per barrel to equal Welsh anthracite coal at $6 per ton.

I have limited my comparison between Welsh anthracite and liquid fuel—

1. Because oil is unquestionably the richest fuel now in use.

2. Because anthracite coal burned under artificial draught is the only mineral fuel that approaches oil in efficiency.

3. Because advocates of oil as fuel have made misleading comparisons between oil and what are not high grade bituminous steam coals. I have yet to find in their verbal or printed statements of a single comparison with Welsh anthracite coal, and I have yet to learn of a single authenticated case of dry steam evaporation beyond 14.2 pounds of water per pound of oil, deducting nothing for use of steam in the process of vaporizing the fuel.

Those of you who have used Welsh anthracite coal in the making of water gas have learned two lessons:

1. That you need a coal containing the largest proportion of lumps and the lowest percentage of screenings.

2. You need a coal that has cohesion when under heat, or that does not disintegrate and close the interstices between the lumps in the generator.

For steam making, a softer grade of coal than you desire has been found advantageous.

We importers are just beginning to have the power of selection and discrimination.

Not every brand of Welsh anthracite is well suited for gas to steam making, interchangeably.

It has been my privilege to read much of the correspondence that has come here from the miners and shippers of Welsh anthracite coal. Each uniformly holds up his hands in holy horror at the poor grade that is imposed by all other shippers upon ignorant California buyers, and with a quite common business phariseeism, they thank God that he made their coal so much better than that of their neighboring mines, and in the same letter they ask six pence per ton more for their coal, which usually they waive under the competition from the same neighbors.

Generally the output of the mines is limited, varying from 80 to 500 tons per day, and it has frequently happened because of this limited outturn and the short time allowed by charter for the loading of ships, that the cargo is not entirely composed of the brand that is contracted for.

Again, contracts call for double screened lump coal.

This means that the coal shall be screened at the mines and again as it goes on board ship. From the amount of breakage in cargoes received, one is led to question whether much of the coal was ever screened at all.

Again, the coal was originally introduced as coming from what is called the Big Vein, and consumers are sometimes deluded with the statements that they get it. I think it safe to say that for several years at least, no Big Vein coal has been sent to this market.

In conclusion, I have endeavored to give you some facts respecting this grade of fuel, and they are based upon perhaps the most extensive experience that any one on this Coast has had.

As to the future, as it looks to me, the struggle for this market will lie between Vancouver Island, with its bituminous coal, Wales, with its anthracite, and California and Peru with their petroleum.

So long as cereals are so prominent an industry, and their shipment shall attract tonnage to land Welsh anthracite coal at anything near the present rates, the demand for this grade of coal must continue to increase.

When petroleum can be landed at such a price per barrel that, taking its evaporative power into consideration, it will prove itself cheaper than Welsh anthracite coal, then oil will be given preference for steam fuel.

It will, however, be a rueful day for the California farmer when either Vancouver Island, with steamers, or Lower California with oil, shall absorb the coal business now enjoyed by those distant coal shipping ports that load American and British wheat carrying ships with coal for California.

The farmer pays the freight on the wheat that he ships, in that he receives for it the difference between the European prices and the freight rates paid the vessels.

The exports of wheat from our State will range about 800,000 tons. In 1893 our imports of coal in wheat carrying ships was about 400,000 tons. These vessels were drawn here because the coal freight inward, plus the grain freight outward, promised their owners a profit. Take the coal freight away, and either the grain must pay the total or the vessels will refuse to come, and the consequent scarcity will so raise the wheat freights that without a corresponding advance in the European markets, the present disadvantageous position of the California farmer will be rendered more deplorable than it is now.

Discussion.

On motion of Mr. Eichbaum the thanks of the Association were tendered Mr. Howard for his very interesting paper. Mr. Jones in seconding the motion said:

I would like to express my thanks to Mr. Howard for his exceedingly interesting paper. I yesterday devoted considerable time to the question of Welsh anthracite, and in thinking it over I wrote down a few questions that I intended to ask Mr. Howard after hearing his paper. He has, however, answered all of the questions that I had in mind to ask, and in a most admirable way; and I wish to express my personal thanks to him.

The President—The remarks of Mr. Jones are very pertinent. This paper is a very interesting one, and is of technical and scientific value, and I hope it will be thoroughly discussed. I am informed that Mr. Eichbaum is the pioneer user of Welsh anthracite coal on this Coast for water gas purposes, and I would like to hear from him.

Mr. Eichbaum—I believe that is true, and it may be of interest to know the conditions under which I found this coal, and the result obtained. On taking charge of the works of the Pacific Gas Improvement Company, in 1883, they then belonged principally to Mr. Charles McLaughlin. I found about 20 tons of this coal lying in a corner of the coal house, which they told me they could not work, as it destroyed the grate bars. They had used about 10 tons of it, and then thrown it out. It was used in making water gas. I looked the coal over, and, being well acquainted with the Lehigh article, this coal appeared to me to be of a quality that could be used. I found it could be imported at a much less price than Lehigh coal, and I began trying it. I found, just as reported to me, that it could not be used unless treated differently from other coal, because its tendency is to burn so close down on the bars that it would invariably melt either the wrought or the cast iron. Instead of allowing the coal to come right down on the bars, therefore, I placed about 6 inches of clinkers on them before charging the generator, and found there was no further difficulty about its melting the bars. In using that coal it is necessary to be very careful, in starting the generator, to have clinkers placed on the bars. You should blow not more than 10 minutes, then put on a little steam and let that go to waste, otherwise the bars will melt directly. I have no doubt there are others present in the room who could give the same experience with reference to the melting of the bars. What Mr. Howard says is particularly true about the screening. I am satisfied that most of this coal that comes here has never been screened for the gas companies—I mean screened from the size of a pea to a grain of wheat. We generally use a three-eighths screen, and in some cases we find as much as 35 per cent. of screenings in part of a cargo. Some of it comes here without being screened at all. We used this Welsh anthracite coal straight along and sometimes we used nothing else. We have paid as high as $15 a ton for Lehigh coal, and, without going into the prices for the past ten years, it is sufficient for us to know that it has now gotten down to $6 per ton, as Mr. Howard says.

Mr. Howard—The difficulty with importers is that we do not know what we are getting. Perhaps we buy a brand of coal, and, on looking at the schedule, or list of mines, we find that that particular mine is supposed to be working a little vein, or a deep vein, as the case may be. The mines vary in output from 80 to 500 tons per day. On receiving an order they do not have time to produce the required quantity in time for the ship's charter, and they borrow one from the other. They then brand it and ship it all under the name of the coal which you have ordered, but it is beyond the ways of Providence to find out exactly what coal is in it.

Mr. Eichbaum—After having used this 20 tons of Welsh anthracite coal we were asked by the gentleman who imported it to use 100 tons more. It was during the time that the United Gas Improvement Company had a lease of the Central Gas Light Company's works. On my recommendation they agreed to purchase another 100 tons, and since then its value has been so well known that no more Lehigh coal was imported here for the purpose of making water gas.

Mr. Britton—I can supplement the experience of Mr. Eichbaum with Welsh anthracite coal by the experience of the Oakland Company. We have been using that coal some nine or ten years continuously, and have tried all the different mines and dealers that we could get the coal from. Our experience has been that we sustain an average loss of 35 per cent. on account of screenings. The last cargo of 1,800 tons of Welsh anthracite showed that nearly 60 per cent. was entirely unavailable for gas purposes on that account. Fortunately we have been able to use it under our electric boilers by means of a forced draught. It could not be screened and it had to be forked. We endeavored to use what is known "cobbles," which yielded as much screenings as the average coal. If dealers could induce the shippers to send to this market the quality of Welsh anthracite coal that is available for gas purposes only, and separate that from the coal used for steam purposes, it would certainly be an advantage. Where it is not used for steam purposes I think there is always a loss. Some arrangement should be made with the shippers who control the Welsh anthracite market to have a character of coal brought here in which a certain percentage of screening could be at least guaranteed.

Mr. E. C. Jones—Our Company is a large user of Welsh anthracite coal. It was formerly the belief that Welsh anthracite must be mixed with English patent coke in generators, and in charging the generator it was the custom to have a portion of patent coke mixed with the coal to lighten up the fire. Some time ago, however, our Company ran out of patent coke, and we tried the experiment of using Welsh anthracite coal by itself, and with excellent results. At our North Beach works we are using it, and we use no coke. At the Potrero we are mixing with it some gas coke which we happened to have on hand, but we are using a very small portion of it. We mix the screenings of the anthracite breeze with the tar which has been previously boiled. We boil the tar, removing perhaps one-half the water. In an average cargo of Welsh anthracite coal carefully selected I think there should be enough screenings to make steam for running water gas works.

Mr. Britton—We have not used any patent coke in making water gas for two years. We find that we get absolutely better results without it. We used about one-fifth patent coke and four-fifths anthracite, and it required about 38 pounds of coal and coke mixed; while ever since we discontinued the use of the patent coke our yield has not run over 32 pounds of coal, and sometimes only 30. We use our coke breeze mixed with oil tar under our boilers. We vaporize the tar with steam, use the breeze as a bed for the tar, and get results without any injury whatever to our boiler.

The President—I may be mistaken, but I think at one time the San Jose Gas Company imported coals from Colorado.

Mr. Eichbaum—They did.

Mr. Allen—I sold the most of the Colorado anthracite coal here to the California Sugar Company, and that is the very best coal. The freight is $8 per ton, which at present precludes its being a successful competitor with the Welsh anthracite coal. At lower prices it might become such. That coal comes in absolutely clean. I rather think the Welsh anthracite coal is screened, but from its friable nature it is broken up on the trip.

On motion the Association took a recess until 1:30 o'clock P. M.

FIRST DAY—AFTERNOON SESSION.

President Quilty reconvened the meeting at 1:30 P. M.

The Secretary announced that through some inadvertence the "Wrinkle Department," edited by Mr. T. R. Parker; had not been assigned a fixed place on the programme for the day, and it was determined to have the "Wrinkles" presented at the time which seemed most opportune for their discussion.

The President then introduced Mr. J. Bryant Grimwood, of the San Francisco Gas Light Company, who read the following paper on

TECHNICAL GAS ANALYSIS.

The advantages of gas analysis are so apparent that it seems quite unnecessary to dwell long upon that fact. A knowledge of the constituents per cent. of a gas at the various stages in the process of manufacture at the works, or, on the other hand, at any point about town where it may be used as a motive power is vastly important to the gas engineer. This knowledge, however, if of any practical value, must be quickly attainable.

The results of most chemical investigations are arrived at only after hours or even days of long and tedious operations. This was largely the case in gas analysis in its incipiency, but since those pioneer days of crude methods and clumsy apparatus, many different systems have come into practice whereby a complete analysis may be made in an incredibly short space of time.

In view of the widespread interest in the subject which has lately been manifested by gas men on this Coast, it may not be out of place to describe the methods and apparatus employed for the daily analysis at the North Beach station of the San Francisco Gas Light Company.

We use the apparatus devised by Prof. Dr. Walther Hempel, of Dresden, Germany, for his technical analysis. By the exercise of ordinary care the results obtained with it so nearly approximate those of the ex act analysis over mercury that, owing to this and the ease and facility with which it is manipulated, it ranks among the finest techno-chemical operations.

From the very nature of a gas, it is obvious that a volumetric determination is most practicable, and for that purpose a glass tube containing exactly 100 cc. is used. This is divided into 100 parts equal to 1 cc. each, and these parts are again divided into fifths. Half of one of the small divisions can be estimated with the eye quite accurately enough, thus affording measurements as small as 1-1000 of the total volume, or 1-10th of 1 per cent. This graduated tube, or burette, as it is called, is supplied with a glass stopcock at each end and is mounted perpendicularly on a wooden or iron base. Above the upper stopcock it is reduced to a capillary tube just long enough to accommodate a rubber connection, by which means the gas can be forced over into the pipettes to be described later. At the lower end it is drawn out into a tube about ¼ inch in diameter, bent slightly so as to protrude from the cement with which it is firmly imbedded in the stand. Tightly wired to this end is a rubber tube 3 or 4 feet long, which connects with a similarly mounted glass tube of slightly greater capacity and differing therefrom in having neither stopcocks nor graduations—a plain glass tube, enlarged somewhat at the upper end to facilitate the pouring in of liquids. This is known as the leveling tube, and when filled with water serves the purpose of bringing the gas confined in the burette to atmospheric pressure by merely raising or lowering the tube until the water in it and the burette, the lower stopcock being open, are at the same level. By holding the leveling tube close to the burette so that the water levels coincide, the internal pressure will be the same as that of the atmosphere.

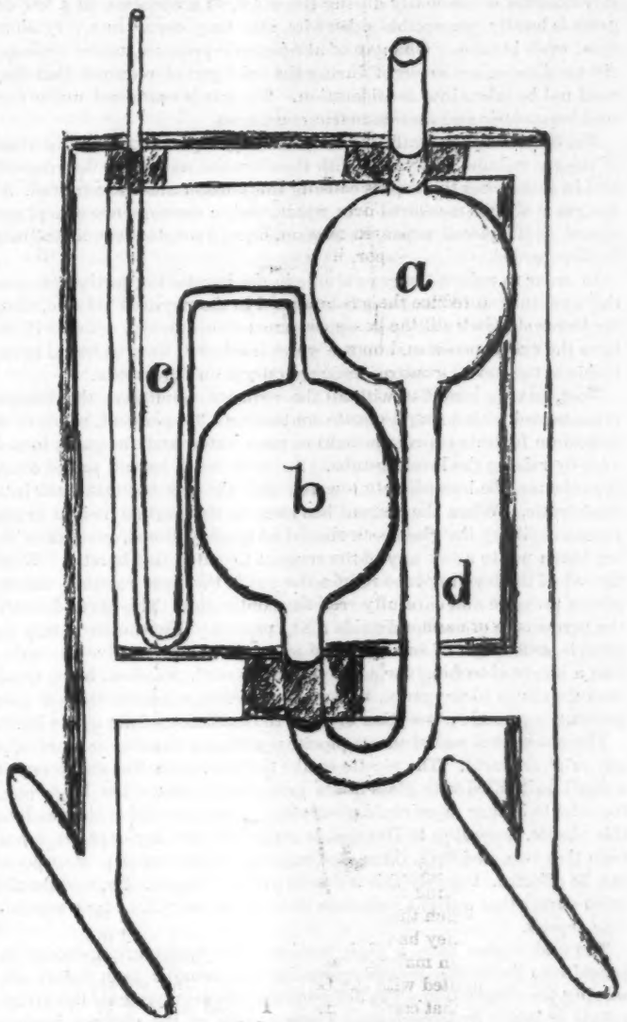
It goes without saying that the leveling tube may be held at any convenient angle while in use, it being not at all necessary to hold it perpendicularly, as is the case with the measuring tube.

The confining liquid used is pure water. As all gases are to some extent soluble in water, before an analysis is made the water in the burette should be saturated with the gas mixture to be analyzed. It can be conveniently done by half filling the burette with gas, closing the cocks and shaking vigorously for some minutes, repeating the operation several times, or by pouring the water into a flask and allowing the gas to bubble through it. After having once saturated the confining liquid it will remain so if the burettes are in daily use.

The analysis is made by bringing the gas in contact with certain chemical solutions or reagents, as they are termed, which possess the peculiar property of chemically absorbing certain of the gaseous constituents, causing a diminution of the gas volume.

All the regeants are kept ready for use in glass vessels known as pipettes. Hempel describes the simple absorption pipette as follows: "It is a modification of Ettling's gas pipette, first used by Doyère for the absorption of gases. It consists of two large bulbs *a* and *b*, connected by the tube *d*, and of the thick walled glass tube *c*, ½ to 1 mm. internal diameter, called a capillary. The bulb *a* contains about 100 c.cm., *b*, 150 ccm., so there will be sufficient room left for the reagent when 100 c.cm. of gas are brought into it. To protect the pippette from breakage and to facilitate its manipulation it is fastened to a wooden or iron frame. On account of the different behavior of wood and glass towards changes of temperature and moisture, it is well to secure the glass only in three places with metal bands, and in such a manner that the capillary extends from 2 to 3 cm. above the frame. A short piece of rubber tubing is forced over the end and wired on."

When it is necessary to introduce a solid into the pipette, a form is used having a cylindrical part in place of the bulb *b* and provided with an opening at the base. After the introduction of the solids this is closed with a rubber cork. The double pipette used for reagents, which must be kept free from contact with the atmosphere, has simply a second set of bulbs partly filled with water, thus forming a movable sea which serves t o exclude the air.



Every pipette is provided with a short piece of glass capillary bent at right angles about 3 cm. from each end, and fastened at one of these ends to the capillary of the pipette with rubber tubing. Further, a stand of the proper height must be provided for the pipettes when it is desired to connect them with the burette. A convenient stand may be made of a couple of pieces of ¾ inch by 6 inch Oregon pine about 15 inches long for top and bottom, and for the uprights two pieces of the same material cut to the desired length, which should be set in some two or three inches from the end of the upper and lower cross-pieces, making a figure resembling the Roman numeral II.

Now we are provided with all the necessary apparatus for the absorption tests, it remains to be seen what reagents are used, in what order the constituent gases should be absorbed, and the conditions under which the analysis must be carried on.

The burettes can be conveniently arranged on a shelf over the table where the operator is at work, and within easy reach. All ammonia and sulphur compounds must first be removed from the gas.

To fill the burette, raise the level-tube, both stopcocks being open, until the air is completely expelled and the water has filled the short capillary. Then close upper stopcock. Make connection with the gas supply, care being taken that no air is trapped in so doing. Place the leveling-tube on the floor and open the stopcock, thus allowing the water to flow back, leaving the burette filled with gas. As soon as a little over 100 c.cm. has thus been collected close the cock again and place the level-tube on the table.

It is of the utmost importance that the sample, together with the apparatus and reagents contained therein, should be of the same temperature as the room where the analysis is made, and that they remain so throughout the entire process. A rise of 1° C. cause an increase of $\frac{1}{273}$ of the total volume; hence the error in 100 volumes equals over .3 per cent. It is therefore advisable to keep the apparatus in the room where the analyses are generally made. I find it a good plan to glance at the thermometer occasionally during the work, as a variation of a few degrees is hardly perceptible otherwise and may occur in a very short time, even indoors. Changes of atmospheric pressure, under ordinary circumstances, are so slight during the brief period required that they need not be taken into consideration. The gas is examined under current barometric and thermometric conditions.

The tension of the confining or absorbing liquid causes an increase of the gas volume. It varies with the chemical nature of the reagent, and in some cases the vapors causing this tension must be removed. As the gas is always measured over water, and in consequence is kept saturated with aqueous vapor, its tension, being a constant condition, may be disregarded.

In order to reduce the gas volume in the burette to exactly 100, raise the level-tube until the gas is compressed to the required volume, close the lower stopcock and open upper one twice quickly, which will relieve the excess pressure, and the water levels will then be found to coincide at the lowest graduation or zero mark on the burette.

Now, having complied with all the required conditions, the burette is connected with a single pipette containing a 33⅓ per cent. solution of potassium hydrate (caustic potash) in pure water, and the gas is forced over by raising the leveling-tube. As soon as it has all passed over, the tube may be immediately lowered and the gas brought back into the burette. When the reagent has risen to its original height in the pipette capillary the glass cock should be quickly closed, great care being taken not to allow any of the reagent to enter the burette. With the aid of the leveling-tube reduce the gas to the then existing atmospheric pressure and carefully read the contraction. This gives directly the percentage of carbon dioxide (CO_2) present. The caustic potash pipette is stuffed full of small rolls of iron wire gauze to give the solution a larger absorbing surface. A 33⅓ per cent. solution, being quite viscous, clings to the gauze, and while affording a greater surface also prevents a possible absorption of O by the oxidation of the iron wire.

The gas is next passed into a pipette containing fuming or Nordhausen sulphuric acid. The pipette is like the first, with the exception of a small bulb filled with glass beads immediately above the large one, likewise to induce more rapid absorption. One passage of the gas into this pipette, according to Hempel, is sufficient, but my experience has been that two, and even three, are required before complete absorption can be effected. Possibly this is due to a weak reagent. The acid should be so strong that a slight reduction in temperature will cause a crystalline deposit.

The acid vapors have a high tension. The gas must therefore be passed into the caustic potash pipette again to remove them before observing the contraction. The difference in volume represents the illuminants or heavy hydrocarbons. These consist of the olefines, having the generic formula $C_n H_{2n}$, and represented principally by ethylene or olefiant gas (C_2H_4). Others of the series are propylene (C_3H_6) and butylene (C_4H_8). Then there are the aromatic hydrocarbons represented by the formula $C_n H_{2n-6}$, chief of which are benzol (C_6H_6) and toluol (C_7H_8). A subordinate series, $C_n H_{2n-2}$, of which acetylene is a member, may also appear. As these several hydrocarbon series cannot well be separated from each other, they are taken out collectively and termed illuminants.

The oxygen in a gas mixture is very effectively removed by phosphorus. The bulb of a single pipette is filled as full as possible with long, thin sticks of phosphorus. Distilled water is then added till the bulb is quite full. When the gas is forced into the pipette, displacing the water, the oxygen present comes in contact with the moist surface of the phosphorus, immediately oxidizing it. The reaction proceeds normally at temperatures from 15° to 20° C., and generally requires no longer than three minutes. The dense white fumes resulting as products of oxidation have very slight tension and are rapidly absorbed by the confining water. Their presence causes no error. The surface of the phosphorus sticks is washed clean by the water, which should be changed from time to time as it becomes saturated with the products of the reaction. If the above operation is carried on in a dark room, the rapid oxidation or burning process may be plainly observed, and its end is sharply marked by the phosphorus ceasing to glow. The pipette, when not in use, must be kept in a dark room or box, otherwise, by the peculiar action of light, it becomes amorphous and inactive.

The presence of certain gases, notably the heavy hydrocarbons, presents in some unknown manner the reaction of phosphorus and oxygen. The illuminants must, therefore, be very carefully and completely removed before proceeding with the oxygen determination.

If it happen that the temperature of the room be too low it can generally be raised sufficiently by placing the hands on the bulb of the pipette.

Next in the order of absorption is carbonic oxide (CO). For this purpose two double pipettes for solid and liquid reagents are used; the first containing a hydrochloric acid solution of cuprous chloride (CuCl) which has been frequently used; the second, a fresher and stronger solution of the same absorbent. The necessity for this lies in the fact that a much used solution will only absorb CO while there is still a certain unabsorbed quantity remaining. The chemical affinity is so weak that as soon as all has been taken up some is given off again. To obviate this difficulty most of the CO is removed by the first pipette, the second completing the work. For the purpose of hastening the reaction the pipette is gently shaken, which may be done without disconnecting it, by rocking the stand to and fro. Three minutes in each pipette is generally long enough to effectually remove all traces of CO. A few spirals of copper wire should be placed in the bulbs of the cuprous chloride pipettes to reduce any cupric chloride which may be present. To make a good cuprous chloride solution, put about 25 g. black oxide of copper (CuO) in a half liter flask and add a number of copper wire spirals reaching to the neck of the flask. Fill with strong hydrochloric acid and cork tightly. At first the solution is dark brown, owing to the oxidizing action of the atmosphere, but, on standing, it becomes clear and colorless.

The remaining gases, consisting of hydrogen, marsh gas and nitrogen, are non-absorbable, and the analyst must resort to other means for their determination. The hydrogen in such a mixture may be determined by leading the gases over finely powdered black oxide of palladium at a temperature approaching 100° C., oxygen being present in excess. In the presence of the palladium black the hydrogen burns to water, two-thirds of the resulting contraction representing the amount of free hydrogen in the mixture. As the total residual volume is too great to be conveniently taken for this test, only 30 c.cm. are measured off, the remainder of the gas rest, as it is termed, being left in the cuprous chloride pipette for further investigation. The 30 c.cm. having been transferred to a plain pipette filled with water, about 95 c.cm. of air are carefully measured off and added. The pipette should be well shaken to insure a proper mixture of the gases. A U-shaped tube containing about half a gramme of the palladium black, intimately mixed with asbestos fiber to lend it porosity, is now inserted between pipette and burette, and the gas is drawn back and measured. Two-thirds of the contraction representing the hydrogen in 30 c.cm., it is a simple matter to compute the total hydrogen by proportion. The palladium tube should be immersed in a beaker of boiling water during the operation to insure a temperature approximating 100° C. A small alcohol lamp could be used for this purpose, but is objected to on the ground that the heat cannot be regulated, and may rise so high that a portion of the marsh gas will also burn. The hydrogen is burned so rapidly that the palladium asbestos is seen to glow at the end nearest the pipette during the passage of the gas. Replace the beaker with another containing water of the temperature of the room, and pass the gas over and back again before measuring.

Marsh gas or methane (CH_4) is always estimated by combustion. A convenient amount, say 12 c.cm., is measured off in the burette, and air is drawn in until the total volume is equal to 80 or 90 c.cm., the exact amount being accurately noted. Passed into a pipette having two platinum electrodes melted into the glass, it is exploded by a spark generated by a small Grenet cell and induction coil. The products of combustion are water and carbon dioxide, the hydrogen and part of the oxygen of the mixture uniting to form water, the marsh gas taking up more oxygen and forming water plus carbon dioxide. Remove the resulting CO_2 with potassium hydrate and note the total contraction due to the combustion of H and CH_4 in 12 c.cm. From this the contraction which would have been caused by explosion of the whole gas rest may be obtained by another simple proportion. As two volumes of H require only one volume of O for complete combustion, the total H (already determined) represents two-thirds of the contraction had the whole gas rest been burned. Thus it is easy to find the contraction due to the combustion of the marsh gas alone, one-third of which is equal to the actual volume of marsh gas.

The nitrogen, which remains chemically indifferent throughout the entire analysis, is determined by difference—*i. e.*, 100, the original volume, less the sum of all the other competent gases, is called N.

Wherever explosion is resorted to, it is advisable to use mercury as the confining fluid. For this purpose there is a specially constructed pipette with a separate and movable bulb joined to the explosion bulb by a short piece of extra heavy tubing, so that the pressure which would otherwise be caused by the mercury may be avoided by lowering the one into which it flows. The explosion bulb has a stopcock at its base and is supplied with a screwcock at the capillary end instead of the ordinary pinchcock. These must both be closed before igniting the gas, and the further precaution taken of slightly reducing the pressure to allow for the momentary force of the explosion. If this is not done the glass will in all probability be shattered.

When water is confined in a tube its surface is never quite level. It rises slightly on the sides of the tube, forming a concave surface called a meniscus. A side view of this conveys the idea of a crescent moon, from which fact it takes its name. All the foregoing measurements are made from the lowest point of this sharply defined line. Some difficulty may be experienced in obtaining proper readings when the light does not fall just right, and for such cases John Hornby suggests that a white card, the lower half of which is blackened with ink, be used. Hold the card behind the burette so that the black portion falls just below the water line, and the meniscus will then appear black by reflected light and may be seen clearly against the white background. This is an excellent device and may be applied in the following manner: Cut the card down to about 2 cm. in length and in width, equal to the diameter of burette. Paste a narrow strip, 3 inches long, on the back at an angle of 45° with edge, and then bend at right angles to the plane of the card. It can then be slipped behind the burette at any moment without the least inconvenience, while a large card held in the hand would be very awkward.

Specific Gravity.—A knowledge of the specific gravity of a gas will often enable one to form a pretty good idea of its constituents. The quickest method, and one which gives very good results, is that of N. H. Schilling, who measured the rate at which the gas in question will flow through a pinhole in a platform disc and compares it with the flow of air through the same hole under similar conditions. The squares of the two rates are in direct ratio as the specific gravity of the two gases, air being taken as one. In place of the apparatus suggested by Schilling, the burette and level tube can be used with quite as good results by attaching a small glass tube, preferably a capillary, to the burette.

A platinum disc is fused onto one end of the tube, which can be made to project slightly beyond the disc as a matter of protection. A sample of gas is drawn into the burette and the above mentioned tube attached. Place the level tube on the table, open the burette cock, and observe with the aid of a stop watch the time required for the passage of any convenient amount of gas.

The relation existing between the flow of a gas through a pinhole and its specific gravity was first observed by Bunsen.

On motion, the thanks of the Association were tendered to Mr. Grimwood for the excellent presentation that he made of his subject.

Mr. John Clements, of Red Bluff, Cal., here read his paper on

THE ECONOMY OF SMALL WORKS.

Mr. President and Gentlemen of the Pacific Coast Gas Association: It is with pleasure I meet with you again after the lapse of another year, as I, for one, feel that our Association has been of great benefit to one and all, and especially so to myself. The information I have received through its channels has been of lasting benefit to me, and I am satisfied will continue to be of greater value if we are spared to meet in the years to come.

Of course we can only make this so by the personal efforts of our individual members. Realizing this to be the case, I will, in my humble way, endeavor to give you my ideas of the management of a small gas works; or, I might say, to repeat to you some of my personal experiences in the management of the smallest gas works within the district comprising the Pacific Coast Gas Association.

The title which I have chosen for my paper (if it can be dignified as such) is "The Economy of Small Gas Works." What I will have to say may be common to you all, and you may say, "Why don't you give us something new?" I will have to give, as an answer to this, the saying of Solomon of old: "There is nothing new under the sun." You will, no doubt, say this might have been the case in Solomon's time, but is not applicable to the present day; besides it is questionable if Solomon ever managed a small or large gas works. The small gas works, like any other business, must be made to pay; and how to do it is the question.

First of all, your plant must be started in good order and ever after must be kept in good order, so far as is consistent with wear and tear, looking out for slight breaks and small leaks, always remembering that the "stitch in time saves nine."

A good, reliable and handy man is essential to the success of your works, to whom you should pay fair wages. Usually such a man will interest himself in the successful working of the plant and thereby assist in the saving of many a dollar for the concern. All things should be kept neat and clean, for nothing will bring about ruin and loss quicker than carelessness and filth. Some gas managers have an idea that a gas works, and especially the retort house, cannot be kept in a presentable condition. This is a mistake. If there is any member of the Pacific Coast Gas Association who doubts this, let him, on his return to his home, start in to see that a few minutes are devoted each day to such work, and I assure him he will not only like the change, but that he will soon find that things will look brighter, work better, and, in the end, become one of the economies of the small gas works.

Again, one of the most important things to do is to keep a just and accurate account of everything that comes in and goes out. By so doing you will be able to know the expense in every department of your work, and, no doubt, will be enabled to see in some places where you could cut down a certain expense, or where it may be dispensed with altogether, thereby making another one of the economies of your small gas works. Again, your gas material, and by this I mean coal, shale, oil, or whatever material you may use in making gas, from the coal when it arrives and is placed in your shed or bunkers, down to your purifying boxes with their contents of lime and oxide, should be kept account of, so that you may know the exact amount of every incidental expense; for when you know the full value of these and many other things, you will be certain to look out for the corners (if any there be) that you can cut off, thereby making another of the economies of a small gas works.

You should know the amount and exact weight of your coal when it arrives by car or boat, and if you are not situated so as to weigh it before dumping into your shed or bunkers, you should prepare to do it; for, in the end, it will pay, if only for the sake of comparison. In filling your charging barrows you should exercise the same care that a merchant does who weighs out sugar to his customers, so that you may be able to know exactly what you are doing—what the results are as to feet per pound and as to what "bye products" you are getting from certain kinds of coal. Doing this you will soon learn the coal or other material that is most valuable to you, thereby discovering another economy of the small gas works.

When material is used in making gas you should know the results. In other words, you should not depend upon a squint through a dirty pane of glass or by a look through a door half open for the purpose of guessing that you have made so much gas, since at best such would be nothing but guessing. You have no doubt heard that guesswork is as good as any when it hits, but to men who are held responsible for the conduct of a gas works no such axiom should be received or accepted.

We must, first, make up our minds what is wanted and get the best at the lowest possible price. In this case what is wanted is a good and reliable station meter, for with its aid you will know what you are doing at your works, and at the end of a month or week you will be able to make comparison with the statement of your consumers' meters. If the difference between the two accounts is great you will at once seek out the cause and find a remedy for the loss, which will be another economy for the small gas works.

Then there are your "bye-products." You should know what you produce in this line. Having done so, you should keep account of the sales of same, so that you will know how much you realize from this source, for they all have a real and fixed value; even though you may use them in your fire they should be accounted for. If you live in a country where wood is cheaper than coal, as I do, you may find it to your advantage to sell your coke and tar and use wood. In any event you should know what your fuel costs you as well as any other item. If these things are ever before you you will find your interest in your work will be greater and all will be closely watched; and your men knowing this, will be inclined to improve their work, with the result that they will become more perfect and efficient, bringing about another economy of a small gas works.

Again, the same care should be exercised outside with that branch of your business which pertains to make good results. As you all know, the electric light man is obliged to keep a constant watch of his lamps to see that the carbons are replaced daily in his arc lamps, and if it is a stormy day or season he is obliged to see that the carbons are in proper line and adjustment before time for starting his dynamos. He watches his incandescent lamps to see that they give the required light, and if he has a suspicion that the life of the lamp is drawing to a close he advises (or he himself makes) renewals. Now, if the electric light man-

ager does this to make his light a success, is it any the less important to us, the managers of small gas works, that the same care should be exercised? I think not. You should make at least weekly rounds among your consumers, especially the larger ones, to see that their lights are giving satisfaction. It is not enough for you to know that your pressure is right at the works, or that your candle power is all that may be required at the photometer; for while these and other things are all that you may desire, still you may not be pleasing your consumer, who may complain of your light. He may complain to you, or he may make the complaint to his neighbor, which latter is the more often done, and they together say you do not furnish them with a good and sufficient light. All this may be caused from the fact that you fail to look after the outside workings of your business. We should, as I say, visit our consumers or cause them to be visited; see that your gas is giving the light that you are warranted in believing it should; show your consumer how to clean his tips; leave a few extra ones with him; show him how to put them in the pillars, and how to take the old ones out; try the L cocks, see if they work free—if they do not, spend a little time in making them do so.

I have known of instances where consumers did not light certain lamps because it was a task (or a nuisance, as they express it) to turn on the gas, and their sending for a plumber or a gasfitter would be an expense that they would not stand, and, in my opinion, they should not stand. If you will look after such small things you will find your consumption greater and your profits better, and you will gain the reputation of being a practical and efficient gas manager. If you have to fight electric light or oil, do all you can to please your customer by giving him a good gas light, which is the most reliable of all the artificial lights known to the social and commercial world at the present time.

Gentlemen of the Pacific Coast Gas Association, these things, to my mind, go to make up the economies of small gas works. They may not be all—they are not all, as many of you know; but they are the important features of the business, and, in my opinion, should have the manager's constant attention.

The manager of a small gas works is expected to be, as my friend Parker would say, metaphorically speaking, a maid of all work; during the day he must see that his man Friday is at his post, and if his man is not he must hug the post himself, draw and clean his fires, prepare his coal, mud his lids and his face at the same time, stay up nights and keep his accounts, prepare his bills, slip out between fires and make his collections, tell his funny stories to keep his customers in good humor while they are swearing at the swelled proportions of the gas bill for the last week or month, and all this time, like Bill Nye's "Prodigal Son," he must wear a bland and sanctimonious smile.

Yet, after all, these are not such terrible things to encounter; they, my fellow members, are the particular and peculiar features of your chosen occupation or profession, and should be met, and I know are met, by you as a pleasant duty, and that you, one and all, stand ever ready to obey the injunction, "Trim your lamps and keep them burning."

Discussion.

The thanks of the Association having been tendered to Mr. Clements for his entertaining paper, the following discussion was had:

Mr. Clark (Philadelphia)—As one of the small gas men, I feel an interest in this subject, having under my charge a dozen small companies. I was particularly impressed with Mr. Clements' ideas of taking care of consumers' burners, the inspection of lights, etc. In my opinion nothing will better assist the superintendent of a small works and his company than this question of attention to the small wants of his consumers; more particularly, to see that he is burning the gas under the best possible circumstances. If a consumer is not using gas economically, he is usually dissatisfied, and his dissatisfaction will extend further. If he is using it economically, he has the cheapest light that he can use, either here or anywhere. He is, therefore, a constant advertisement for the company which is supplying him. A few imperfect tips in a show window of a shop in a small town will cause considerable damage to the interest of the gas company. The idea advanced by Mr. Clements, of a systematic and periodical inspection, is, I think, an excellent one. I am also struck by his remarks on the importance of order and cleanliness in the gas works. Gas works cannot be kept clean, but they certainly can be kept orderly. I have heard it remarked that it did not pay to bestow the necessary labor entailed by keeping gas works in order. I can cite several instances of gas works that are otherwise run profitably in which order is not at all observed, and where everything is dirty. I do not think that is proof at all that it does not pay to maintain order. I think that in those works the results would be better still if order were maintained. It certainly does pay. Some of the most successful works of the country are run by men that have had a naval training. It is a pleasure to enter the works conducted by such men, where everything is in order. Mr. Clements did not refer in his paper to the importance in a small gas works of frequent service meter tests. That is, of course, important in all gas works. Meter tests should be made every third year, in my judgment. Of course a meter should be tested every time it comes out of service and every time it goes in; but I think a systematic inspection every third year should be observed, and I have statistics to show that it pays to so test them. Most of us in charge of large as well as small gas works know the chagrin that a gas man feels when he brings in a complaint from the consumer about the meter. When meters get out to any extent, they generally register against the gas company, and by frequent tests we maintain proper regulation of meters, thus getting paid for our product. I think Mr. Clements did not touch upon the importance of testing mains. That is as important in small works as in large ones, in my opinion. If it will pay in large works, it will pay proportionately in small ones. In the East I know this testing has been very much neglected. Within the last three years the company with which I am connected has given especial attention to this matter of barring the mains annually, and we certainly get back in two years all the money we expend in that way, and I am sure it is a good investment.

Mr. T. Thompson (Woodland)—One thing a small gas man has to contend with is, he can seldom induce the stockholders to give him machinery to enable him to know what he is doing. Often a gas man in a small works has when he starts to go on by guess and do the best he can; then, when some inquiring brother comes along and asks him what he is doing, he is compelled to reply that he has no station meter and but one box to purify with; yet he must know what he is doing as a gas man. How to influence the men with the money to give him his station meter, purifiers and other necessary apparatus for gas works is something that is a personal question.

Mr. Clark spoke of attending to the burners of customers. That is a vexed question. I, for one, know it will pay. But if a gas man starts in to do it at all, and if a customer hears that he will clean up his burners, the gas man will be sent for and kept going. He has to keep up a good heat and measure his boilers by inches every day. He can generally tell by guess how much goes off every night. He learns what is up, by guess.

Mr. Osborne—In our town we have everything with which to make gas. All we lack is consumers. (Laughter.) I believe almost any gas man can make gas, but the question is how to get consumers. During the last ten years that I have been in the gas business an immense quantity of high-power coal oil lamps has been placed on the market, and, in my observation thus far, we have had but one essentially improved gas burner for our assistance; and that is the Welsbach. I will not go into that subject now, for I understand we are to discuss it later on; but I believe that the coal oil men are doing more for consumers, ever anxious for a cheaper light, than we are. What we want is something in the direction of reaching consumers.

Some Telegrams.

The Secretary then read the following telegrams of regrets, congratulations, etc.:

Steubenville, O., July 16, 1895.

The Ohio sends greetings of fellowship, and wishes its kindred Association long life and prosperity. J. Gwynn, President.

New York, N. Y., July 16, 1895.

We send heartiest greeting on the occasion of your annual meeting.
American Gas Light Journal.

Los Angeles, Cal., July 16, 1895.

Am very sorry I cannot attend meeting. Hope it will be a most successful one. W. B. Cline.

Worcester, Mass., July 15, 1895.

Your invitation received to-day, the 15th. It is impossible for me to go to San Francisco at this time. Please extend my best wishes to your Association for a successful and happy meeting.

Yours truly, Chas. D. Lamson,
President of the New England Association of Gas Engineers.

Sacramento, Cal., July 16, 1895.

Important business meeting has interfered to prevent the attendance of Pierson and myself. Best of wishes for a prosperous session.
B. U. Steinmann.

[To be Continued.]

Willson's Method of Converting Calcic Carbide for Enriching Illuminating Gas.

On the 9th inst., U. S. Letters Patent (No. 542,320) were granted to Mr. Thomas L. Willson, of New York, for "certain improvements in the treatment of illuminating gas." Using the words of the specification:

Ordinary illuminating gas, in the condition in which it passes into the main or distributing pipe, holds in suspension more or less aqueous vapor, and in its passage through the mains, which, being laid underground, are maintained at a low temperature, these vapors are condensed, thus giving rise to the annoyance of the accumulation of water at low levels in the mains. My present invention aims to prevent this condensation, or to reduce it to so insignificant an amount as to occasion no practical difficulty. There is an accompanying condensation with ordinary illuminating gas of certain condensable hydrocarbons; but with condensation of this nature my present invention is not concerned.

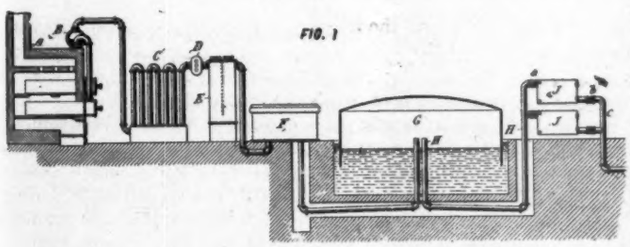
My invention is based upon the property possessed by calcium carbide (CaC_2) of decomposing water and thereby generating acetylene gas. So great is the affinity of this carbide for water that it undergoes decomposition in the air with continual evolution of acetylene. The same property is also possessed by some other metallic carbides, as, for example, barium carbide, though in less degree. There are other metallic carbides, such as aluminum carbide, which do not possess any affinity for water, and with these my invention is not concerned.

According to my invention, I take, for example, ordinary coal gas, or a gas produced from any hydrocarbons by destructive distillation, and after it has been purified in any ordinary manner, and before it is passed into the mains, I bring it into close and repeated contact with calcium carbide (or any other metallic carbide having the power of decomposing water), whereby the moisture in the gas is taken up by the carbide, with an accompanying decomposition of the latter, to generate a hydrocarbon gas, which gas, in the case of calcium carbide, is acetylene. By this means the illuminating gas, at the instant before it enters the mains, is thoroughly dehydrated, so that it contains no aqueous matter which can be precipitated in the mains, or at least not enough to occasion annoyance. At the same time the acetylene gas which is generated from the carbide commingles with the illuminating gas, and by being itself a high illuminant serves to enrich the gas or increase its illuminating power. Thus, at one operation, two very desirable results are produced, namely: The gas is dried and its illuminating power is increased.

In the accompanying drawings, Figure 1 is a sectional elevation illustrating the combination of apparatus employed for producing gas from coal, to which are added two carbide dehydrators for practicing my present invention. Fig. 2 is a section of one of these dehydrators on a larger scale.

Referring to the drawings, let *A A* designate the retorts; *B*, the hydraulic main; *C*, the condenser; *D*, the gas exhauster; *E*, the scrubber; *F*, the lime or other purifier, and *G*, the gasholder. These apparatus

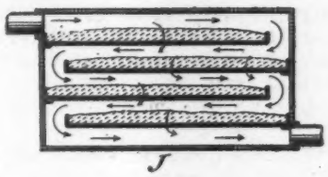
FIG. 1



are or may be of any usual or known construction, being unaffected by my invention.

From the gasholder the gas is taken out by a pipe *H*, which, instead of conducting it directly into the main, conducts it to one or more carbide dehydrators, which, as a whole, are lettered *J J*, and of which two are shown in the drawings, although any number, from one up, may be used. These dehydrators may be of any construction whatever, whereby calcium carbide may be exposed in the path of flow of the gas, so that the latter shall be brought into intimate contact with the carbide. In the construction shown the dehydrators consist each of a casing or shell constituting a chamber in which are placed alternated trays containing the carbide, the latter being preferably in lumps or pieces of, for example, about the size of walnuts, and the trays being so arranged as to cause the gas to flow back and forth in alternation, so as to come into extended contact with the material on all of the trays, and the bottoms of the trays also being perforated, in order that some of the gas may be drawn directly through the tray by passing through the interstices between the lumps of carbide. The casing is constructed so that it may be opened to remove the trays and renew the carbide when necessary. Each dehydrator receives the gas through an inlet pipe furnished with a controlling valve *a*, and the gas passes out through an outlet pipe furnished with a valve *b*. By means of these valves any one of the dehydrators may be disconnected for the purpose of renewing its

FIG. 2.



carbide. In the case of two or more dehydrators, the pipe *H* distributes the gas to those dehydrators that are in action, and the gas issuing from their outlet pipes is conducted by a pipe *c* to the main or distributing pipe, lettered *K*, and which is shown as an underground pipe.

The purpose of introducing the dehydrators between the gasholder and the mains is that, however free from moisture the gas may be when it enters the gasholder, it is liable to absorb more or less moisture from the water used to seal the gas in the holder, and by arranging the dehydrators to act upon the gas as it flows from the holder this moisture is taken up by the carbide.

My present application for patent is not intended to claim broadly the dehydration of an illuminating gas by passing it into contact with calcium carbide, as such matter is claimed in my application, Serial No. 545,466, filed April 12, 1895.

My present application is intended to claim specifically the dehydration of an illuminating gas between the gasholder and the main, and especially the dehydration and enrichment of coal gas by this means.

I claim as my invention the following defined novel features, substantially as hereinbefore specified, namely:

1. The improved treatment of illuminating gas, which consists in passing it, after it has been purified, and before it enters the mains, into contact with a metallic carbide decomposable by water to generate a hydrocarbon gas, whereby the gas is dehydrated and enriched.

2. The improved treatment of illuminating gas, which consists in passing it on its way from the gasholder into the main into contact with a metallic carbide decomposable by water to generate a hydrocarbon gas, whereby the gas is dehydrated and enriched.

3. The combination with gas generating and purifying apparatus and a gasholder, of a carbide dehydrator substantially as described, introduced to be traversed by the gas between the gasholder and the main.

New Method of Sinking Deep Foundations.

Engineering Record says that although the water jet, the sand pump, and the caisson are familiar as valuable and efficient agents for executing foundation work, it would appear that the limit of their range of combination and application has not been reached, since a patent has just been granted to R. L. Harris, M. Am. Soc. C.E., No. 1 Broadway, New York city, for foundation apparatus, of which the arrangement and some features are, as far as we know, new and untried, but quite in line with practical experiments which the inventor has for some years been conducting on a working scale with the "circulation and accretion" processes of excavation and concrete construction in very deep or inaccessible places, especially in quicksands, etc., where the operations have been completely effected from the surface.

The patent claims substantially describe the use of any caisson in which a chamber open on the bottom is formed underneath the deck by the lower walls and cutting edges where the material through which it sinks is removed by forcing water under pressure through vertical pipes from the surface into the soil in the excavating chamber, so as to scour out the material and carry it suspended up to the surface through other vertical pipes passing through the caisson deck and open at both ends.

It is thus proposed to sink the caisson to any required depth through

loose soil without the use of pneumatic pressure or the entrance of workmen into the excavating chamber, the progress being regulated and alignment maintained by turning on and off the jets in different parts of the caisson, and by weighing it in the usual manner. After the caisson has been sunk to the required position it is to be filled with grout, etc., injected through the same tubes, so as to make a solid foundation.

It is proposed to build the excavating chamber with double iron walls, the outer one vertical and the inner one sloping inwards from a common cutting edge; sections of the inside wall or skin are to be separately hinged at the top so as to form doors, opening inwards, but ordinarily held closed by the pressure in the inside of the chamber. In the event of a serious obstruction being encountered under any point of the cutting edge, sufficient water pressure is to be applied to the upper side of the adjacent inclined door to open it and enable a suitable cutting or drilling tool to be passed from above through the opening, and cut or disintegrate the obstruction near the cutting edge and allow it to be removed or forced aside.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Rockport (Mass.) Gas Company has been incorporated by Messrs. James P. Merridew, George A. Lowe and Roger H. Tarr. The capital stock is put at $30,000. This place is a post village of Essex county, Mass., in a similarly named township, and is located on the Gloucester branch of the Eastern Railroad at a point 36 miles northeast of Boston and one mile west of Cape Ann. It is also on the Atlantic Ocean, and a local summer resort, known as Pigeon Cove, brings a good deal of grist to its mill. Its main business dependences are granite quarries and cotton factories. Population of the township, about 4,800.

AT the annual meeting of the Norwalk (Conn.) Gas Light Company the officers elected were: Directors, E. J. Hill, E. K. Lockwood, Eben Hill, John A. Osborn, R. H. Rowan, John H. Ferris, P. L. Cunningham, W. F. Bishop and J. P. Treadwell; President, E. J. Hill; Vice-President, E. K. Lockwood; Secretary, Henry Chasmar.

THE Darby Gas Company, of Darby, Pa., has been purchased by Baltimore capitalists, who propose to extend the existing main system to the adjoining boroughs of Colwyn, Sharon Hill, Collingdale, Yeadon and Lansdowne. We understand that the Messrs. E. and W. L. Verlenden and W. H. and E. Whitely, who formerly controlled the Company, are to remain on the Board of Directors.

MR. B. F. HARRIS, JR., President and General Manager of the Urbana and Champaign (Ills.) Electric Street Railway Company forwards us the following copy of a notice recently printed in the local papers: "We hereby give notice that we have become the owners of the Champaign and Urbana Gas Light and Coke Company, lately owned by the William Walter Phelps estate, and operated in the name of Thos. R. White, Jr., Agent. We have also acquired, by purchase, the gas franchise granted by the Champaign City Council to C. H. Brampton, April 17, 1895. It is our intention, so soon as we get the business well in hand, to make many improvements and extensions in the plant, making it modern in every respect. It will be our policy, as in our other properties, to meet the wishes of our consumers and to give them all the advantages of good gas at the lowest price consistent with business methods and their patronage. We desire especially to encourage and offer inducements for the use of gas for cooking and heating purposes. Until further notice the price of gas will be $1.50 per 1,000 cubic feet, if paid before the 10th of the month; if paid after the 10th of the month, $1.75 per 1,000 cubic feet."

THE gas works at Chatham, New Brunswick, which were shut down some months ago, are to be again operated, some capitalists from St. John, New Brunswick, having subscribed the necessary money. The correspondent who forwards this item further remarks, "This will be welcome news to many, with whom the present system of electric lighting is not very much in favor."

THE proprietors of the Newton (N. J.) Gas Light Company were some days ago called upon by the authorities to pay a fine of $100 for polluting the waters of the Paulins Kill with waste from the works' drains.

THE American Heat and Light Company, of Hagerstown, Md., have arranged for the construction of an additional gasholder, rated to hold 125,000 cubic feet.

MR. B. E. LETANG, of the Jackson (Cal.) gas works, has determined to add an electric lighting annex to that plant. Cheap water power is available there all the year round.

THE local papers of Wheeling, W. Va., are demanding that the Gas Board—the members whereof have control of the municipal gas works—shall present to the Council each year an itemized statement of the business transacted by them on public account.

IN connection with the above we reproduce the following, from a late issue of the Wheeling *Intelligencer*: "A reporter asked Secretary Fee, of the City Gas Board, what about that itemized statement of the expenses asked for by the City Council. Mr. Fee said he was preparing, and would have ready for the next meeting of Council, a complete and comprehensive statement, not only for 1894, as had been requested, but for 1893 and 1894, and the first six months of 1895. It was his own opinion and that of the Board that the Council should have all these for the purpose of comparison. When asked about the apparent increase of wages, and diminution of gas made, Mr. Fee declined to go into figures for publication, but intimated that the statement, when forthcoming, would show that the increase was more apparent than real. As to the expenditure for coal, he said the contract price had been $1.34 a ton for years, but subject to increase or decrease on account of changes in wages paid miners. If the 69 cent scale were paid, and a reduction made in wages to 60 cents, the city would be entitled to a reduction of 9 cents; also, if wages were increased to 75 cents a ton, the city would be obliged to pay 6 cents a ton more. Last year the strike cost the city a good deal of money. Besides this, about $19,000 was spent for improvements which do not have to be made every year. Some items in the forthcoming statement, the Secretary says, will require explanatory foot notes. The idea is to make it so complete that the Council can get all the information on the subject from it that there is to give."

THE following is the text of a bill, which is entitled "An Act to enable and provide for the purchase, by any city or town in the State of California, of a water or gas or electric system, or any of them." It was prepared mainly through the efforts of Mr. Charles W. Quilty, of the San Jose Light and Power Company, whose address (as President of the Pacific Coast Gas Association) before the Coast Association, delivered at the third annual meeting of that body last July, had much with reference to the dangers threatening gas, water and electric light investments on the Coast from proposed municipal absorption of such corporate concerns. The provisions of the Act are:

Section 1. Any city or town in the State of California, whenever by resolution passed by a two-thirds vote of its City Council, or Trustees, or other governing body, and approved by its Mayor or regular presiding officer, determines that it is necessary and expedient that such city or town should own and control its own water or gas or electric light system, or any or all of such systems, it shall proceed to acquire any or all of such water, gas or electric systems then engaged in supplying such city or town, or its inhabitants, with water, gas or electricity, by serving on such water, gas or electric light company, or any or all of them, a copy of such resolutions as passed.

Sec. 2. After a period of 30 days from date of such service, said city or town, by its governing body, shall select an appraiser, and said water, gas or electric light company shall select an appraiser, and those two appraisers shall select a third disinterested appraiser.

Sec. 3. Within 10 days after the expiration of the 30 days mentioned in the preceding section, the Mayor or other presiding officer of the governing body of such city or town must fix a day on which said appraisers shall meet and qualify, and so notify said appraisers, in writing, who shall thereupon meet and qualify, and select a place for meetings of said appraisers.

Sec. 4. Said appraisers shall then proceed to value and appraise the franchises, privileges, easements and other properties of said water, gas or electric light system, or any or all of them, sought to be acquired; and in making such appraisement may consider the first cost of any of said plants, its earning capacity, its commercial value, and what it would cost at the present time to duplicate the same, and in making such appraisement said appraisers shall have the right to fully inspect the books and papers of any gas, water or electric light company sought to be acquired; and such gas, water or electric light company shall at all times be accorded a full hearing by such appraisers, who shall keep a record of their proceedings.

Sec. 5. Within 90 days after qualifying, or such period further granted by said governing body of said city or town, said appraisers, or a majority of them, shall file with the clerk of said governing body of said

city or town their appraisement or valuation of said water, gas or electric light system, and which said valuation shall be the price for which said city or town shall purchase said water or gas or electric light system, and for which the corporation, company or individual owning the gas, water or electric light systems, or any of them, shall sell the same to said city or town.

Sec. 6. Should either party, either the city or town purchasing, or the corporation, company or individual selling, be dissatisfied with aforesaid appraisement as made and filed, then either party may, within 60 days after the filing of the said appraisement, file in the Superior Court of the proper county a petition for a rehearing on said valuation and appraisement, which hearing shall be conducted according to the regular procedure of said Court, and the judgment of said Superior Court shall be a final determination of the value of said water, gas or electric light systems, or any or all of them appraised.

Sec. 7. Such company or corporation or individual, whose system of water, gas or electric light has sought to be acquired, shall then prepare proper deeds and papers of transfer and conveyance, and upon payment to it or them by said city or town of the final appraised value of said system or systems, shall transfer and deliver the same to said city or town, and should said city or town fail or refuse to purchase, or said company, corporation or individual fail or refuse to sell and transfer said water, gas or electric light system within one year after such appraisement or final judgment of the Superior Court, then either party to said purchase and sale may enforce the said purchase or sale by application to the Superior Court as for the enforcement of other contracts.

Sec. 8. The pay of said appraisers shall be $10 per day each, for each and every day actually employed by each in making such appraisement, and shall be paid by the city or town commencing the foregoing proceedings. No city or town in which there is a water, gas or electric light system or systems operated by a private company, corporation or individual, shall construct a public system of water, gas or electric light works, but shall proceed to acquire the same, as set forth in this Act.

Sec 9. When there are two or more gas works, or water works, or electric light works, in any city or town which elects to avail itself of this Act, then such city or town shall purchase both systems of such water works, or gas works, or electric light works, or none at all.

Sec. 10. If such city or town, or the company, corporation or individual owning and operating water, or gas, or electric light works, who may become parties to the proceedings contemplated in this Act, fail to carry out the provisions of this Act, within the time specified therein, then such neglect and failure shall be construed to be an abandonment of the original proceedings of acquisition, but future proceedings by any city or town, water, gas or electric light works, shall be conducted according to the provisions of this Act.

Sec. 11. This Act shall take effect and be in force from and after its passage.

Mr. James M. Hadden, of the New York Marine Paint Company, whose headquarters are at Poughkeepsie, N. Y., reports that the Company is doing a good business, several large gas companies throughout the country having recently forwarded large orders for the paint, many of which were duplicates—a fact speaking volumes for the efficiency of the material.

The Fort Wayne (Ind.) Electric Company has agreed to construct for the city of Owensboro, Ky., an electric lighting plant, to be operated on municipal account, for the sum of $21,964.

It looks as if the present owners of the Syracuse (N. Y.) Company are about to dispose of that property to the Hiscock-Dunfie combination. The stock certainly ought to be worth $170 per share.

In our last issue we reported that Mr. Thomas Barrett, of this city, had purchased the shares in the New Memphis (Tenn.) Gas Light Company, held by Capt. Samuel Brown, of Pittsburgh, Pa., and from the way in which the sale was stated it could only be inferred that Mr. Barrett purchased the shares for his own account. The real state of the case, however, is that Mr. Barrett was acting for several well known residents of Memphis.

The regular semi-annual dividend of 3 per cent. by the Gas Light Company, of Augusta, Ga., has been declared. It is payable on demand.

Mr. F. J. Opp, of Cincinnati, Ohio, advertises that the following certificates of capital stock in the Cincinnati Gas Light and Coke Company, standing in his name on the books of the Company, have been lost: Nos. 17,986 and 17,987, two shares each, dated October 2, 1891; and No. 26,244, two shares, dated January 18, 1894. He has applied for duplicates.

The Riparian Commissioners of New Jersey have granted the Perth Amboy Gas Light Company a strip of land along the Raritan river, on which it is said the Company will construct a new works.

The Birdsboro Gas Light and Fuel Company, of Birdsboro, Pa., has been incorporated. This place is a post village of Berks county, Pa., and is on the Schuylkill river, and on the Philadelphia and Reading Railroad, at its junction with the Wilmington and Reading Railroad, 9 miles southeast of Reading. It has a rolling mill and several iron furnaces. Population, about 3,800.

The Southbridge (Mass.) Water Supply and Gas Company's offices have been removed to one of the rooms formerly occupied by the Board of Trade.

The cars of the local trains to Oakland, Cal., are now lighted by Pintsch gas, and the service is eminently satisfactory.

The Columbus (Ohio) *Dispatch*, of July 24th, had this to say: "A new feature in manufacturing business in Columbus was inaugurated during the quarterly meeting of the Columbus Gas Company, when the Directors authorized the adoption of the plans for profit sharing recommended to the Company at the March meeting by President Emerson McMillin. At that time the plan was quietly discussed and referred to the stockholders for consideration. Now the plan has received the indorsement of the management and becomes at once effective, giving all the employees a dividend on their earnings the same as the shareholders. The dividends will be based on the amount of their pay during the period for which the stock dividend is declared for stockholders and in the same per cent. At present the dividend is 5 per cent., payable semi-annnally at the rate of 2½ per cent. The conditions imposed are that the employees are to receive scrip exchangeable for stock, until their holdings amount to $300, when it is optional whether they take cash or scrip. A further condition is that the profit sharing applies to men more than a year in continuous service. The next dividend under the plan will be in November, when it will be paid to stockholders and employees alike for the six months ending October 1, the employees sharing to have been in the employ of the Company a year previous to April 1. The innovation is the first in the city and among the first in the State, which will make its operation a subject for much consideration by manufacturing interests."

Messrs. Boardman, Manrara & Knight have everything in readiness to go on with the construction of the works at Tampa, Fla. It is their intention or purpose to be ready to supply gas on or before Dec. 1. The only reason that active work is not going on is the provision in the health laws of the city which prohibits earth excavations until some time in the fall season—on or about October 1st, we understand, is the date when such excavations may be made.

The Wilmington (Del.) *News*, of July 23d, reports: "The Wilmington Coal Gas Company, which has a large contract for lighting the city's streets with gas, is making interesting experiments with the lights. Some time ago the Company asked permission of the Street and Sewer Department to make some experiments of using the Welsbach burner. The Department replied that the city had nothing to do with making the experiment. The contract with the Gas Company required the Company to supply gas lights of a certain candle power, and that so long as that was done it was a matter of unconcern to the city what kind of burner was used. The representative of the Company who asked the permission stated that while it would cost the Company considerable to furnish the new burners for city lighting, yet they believed that a better light could be furnished at a lower cost to the Company than with the old burners. The Department again thought that this was a matter with which the city had nothing to do, and that if the Gas Company could make more money out of the lighting and at the same time furnish a better light it would be but business for the gas people to do so, and the city would not object. All that the Department asked was that the lights come up to the required candle power. This being the case, the Gas Company began its experiments with the new burners, and a number of them have been put in. Some of the burners have been placed on Washington street, a large number on West 10th street and one on West 4th. The lamps are left burning all day, that being cheaper than allowing the boy lamplighters to light them. The boy simply turns them down in the morning and turns them up in the evening. In this way the burners are always kept in order. People who live in the sections lighted by the new burners, and people who travel the same streets at night are delighted with the light which they give. There is nothing which surpasses them except an arc electric light. The best lighted portions of the city are those where the new burners are in use, and the people are in hopes that the experiment of the Gas Company will be a success, and that all of the gas burners in the city will be replaced with the Welsbach style."

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, AUGUST 5, 1895.

The Market for Gas Securities.

The market for city gas shares showed unwonted activity during the week for this season of the year. The tendency in Consolidated to higher values was quite marked, sales having been made at 143, which is virtually a gain of 3 points since time of last writing. The opening to-day (Friday) came in at 143 to 143¼, and we look for a substantial increase in values. Rumor is busy again with the suggestion that the dividend rate is to be increased, if not for this quarter, certainly for the last three months of the year. We are inclined to believe with rumor this time; and in that view of the case the shares ought easily reach 175. Equitable is somewhat sluggish and lower, holders asking 195, and purchasers are offering two points less. East River common is inactive, with no change in the quotations, and the same remarks apply to Standard. Mutual holds firm, at 170 bid; but we imagine a bid of 175 would not bring out any stock.

Brooklyn shares are nominal, but lower, and it is in the cards that the people in control of the Equity are about to take a decided stand over the effort to secure an enlargement of the Company's field of operations. Chicago attracted much attention during the week, and strength of a pronounced type was predominant in it. The opening to-day was at 57½ to 57¾. Our advice is to purchase Chicago at the market figures. Western, of Milwaukee, is still mounting, with the probability that the rise will not be checked this side of 75. Detroit is 29 bid, but we would rather sell it than buy it at that figure. Lacledes are up, 25½ being bid for the common, and the preferred is 85, bid. Bay States are slow and halting. Baltimore is virtually unchanged; ditto Consumers, of Jersey City. The latter is cheap at anything under par.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks,
35 WALL ST., NEW YORK CITY.
AUGUST 5.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	143	143¼
Central	500,000	50	140	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	193	195
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	113	115
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	170	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
Northern	150,000	50	90	91
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	30	32
Preferred	2,000,000	100	54	57
Bonds	3,500,000	1,000	91½	92½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	64	67
Preferred	5,000,000	100	107	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	107	..
Yonkers	299,650	50	101x	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" " S. F. Bonds	330,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	90	..
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	225	..
" Ctf's	700,000	1,000	99	100
Williamsburgh	1,000,000	50	210	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	18	21
" Income Bonds	2,000,000	1,000	33	..
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	70½
3d " " "	3,000,000	1,000	..	53
Buffalo Mutual	750,000	100	120	..
" Bonds	300,000	1,000	95	100
Chicago Gas Co.	25,000,000	100	57½	57¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds	7,650,000	1,000	93	93½
Columbus	1,089,000	..	63	66
1st Mortgage	1,085,000	..	91	93
Consumers, Jersey City	2,000,000	100	89	92½
" Bonds	600,000	1,000	100	105
Cincinnati G. & C. Co.	7,000,000	100	203	203¼
Consumers, Toronto	1,600,000	50	184½	187
Central, San Francisco	.....	..	90	100
Capital, Sacramento	.....	..	..	50
Consolidated, Baltimore	11,000,000	100	..	63
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	29	..
" Con. Bonds	4,312,000	..	72	73½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	72	74
" Bonds	2,000,000	..	84	86
Hartford	750,000	25	130	138
Indianapolis	2,000,000	..	143	153
" Bonds, 6's	2,650,000	..	105	106
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	84	86
Bonds	1,000,000	1,000	88	90
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	25½	26
Preferred	2,500,000	100	85	87
Bonds	9,034,400	1,000	96	..
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
New Haven	.....	25	225	..
Northwestern Ohio Nat. Gas	.....	..	48	..
Oakland, Cal.	.....	..	42½	43
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87¼	90
San Francisco, Cal.	10,000,000	100	72½	72¾
St. Paul Gas Light Co.	1,500,000	100	68	70
1st Mortgage, 6's	650,000	..	..	..
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	800,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	66½	67½
Bonds, 5's	3,556,000	..	95½	96½
Wilmington, Del.	500,000	50	188	190

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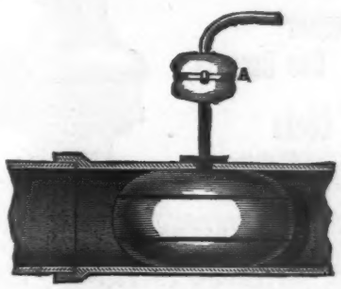

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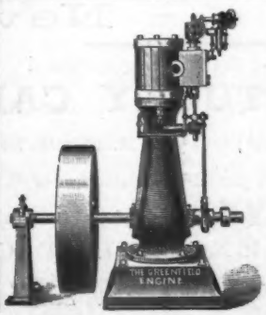

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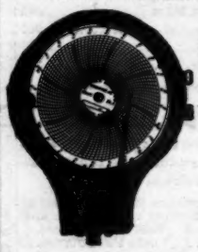

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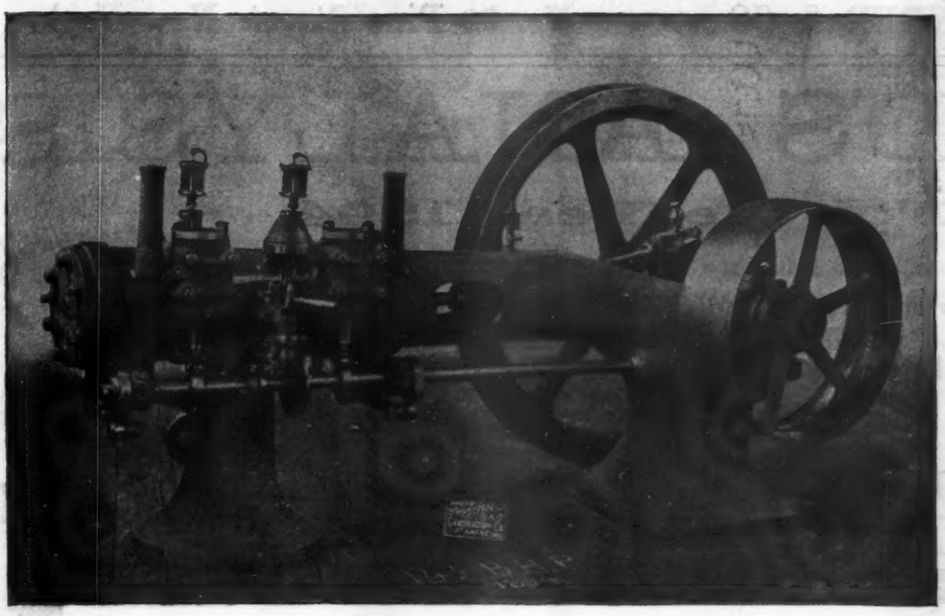

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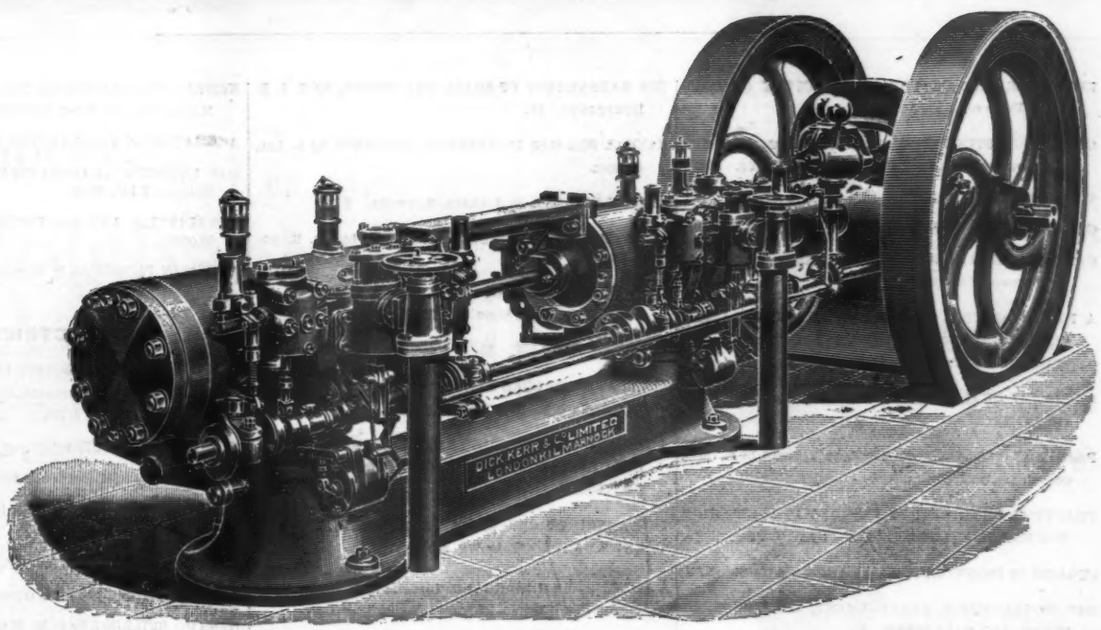

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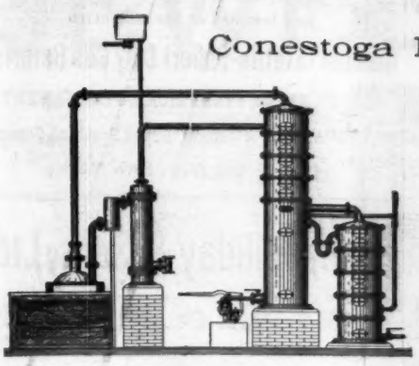

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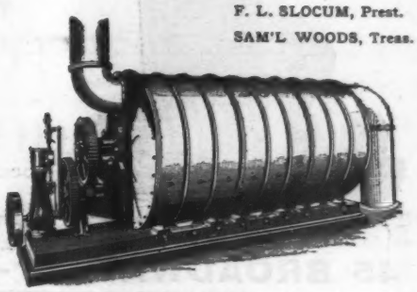

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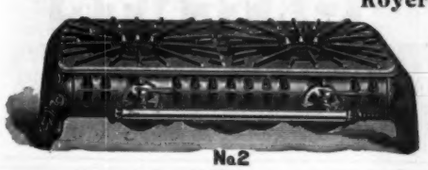

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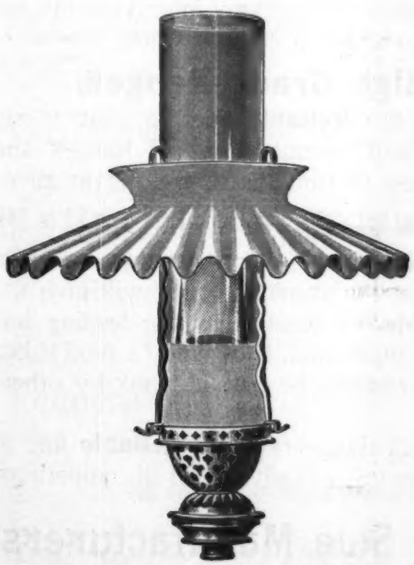

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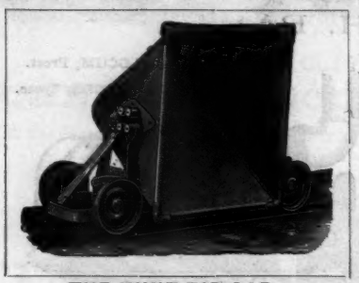

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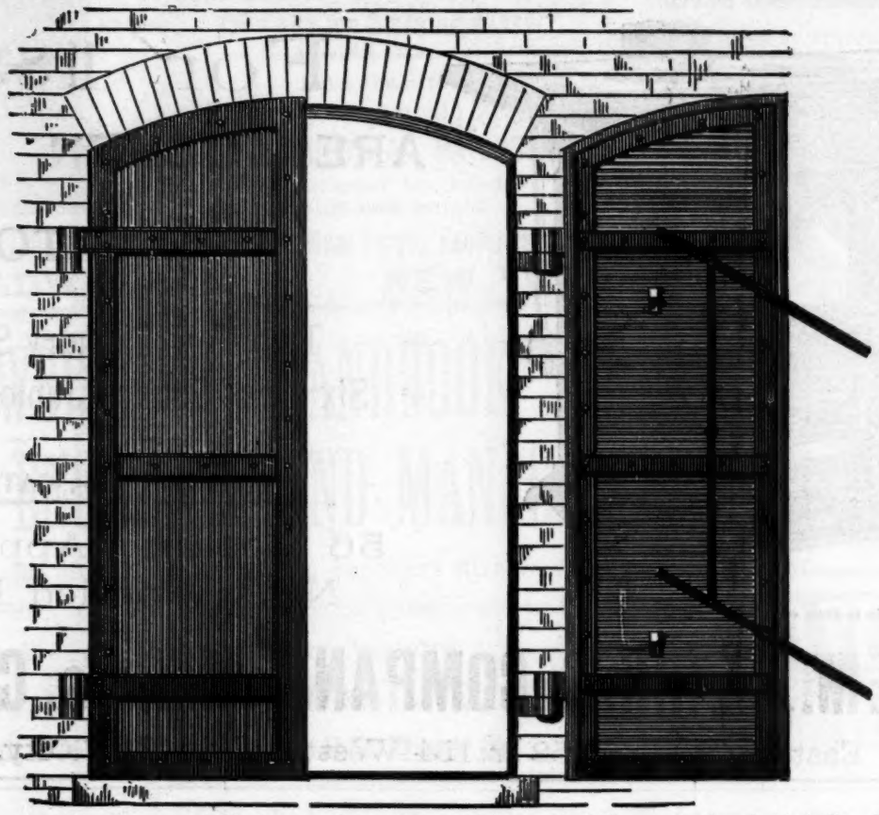

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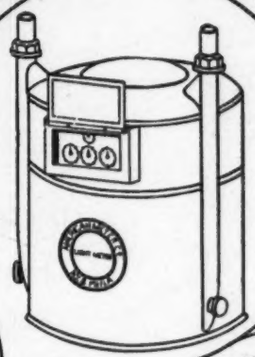

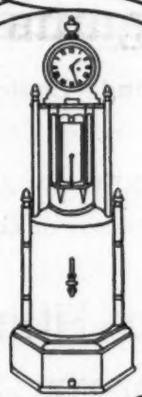

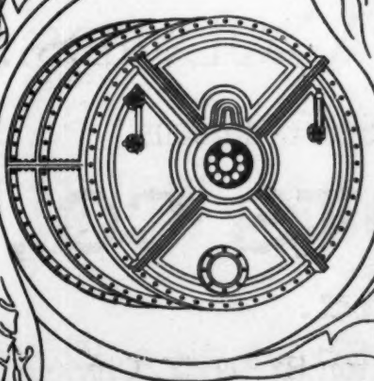

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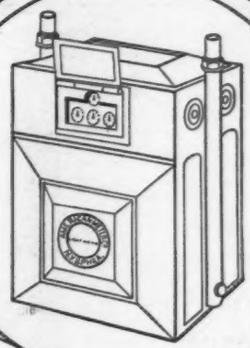

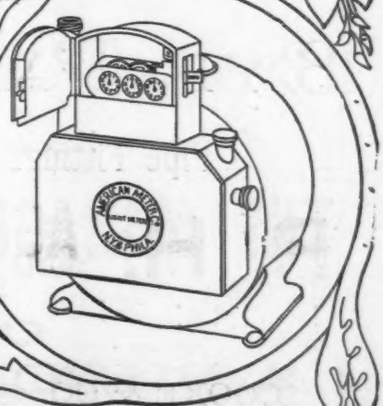

PUBLIC LIGHTING TABLE.

AUGUST, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Thu.	1	12.40 AM	4.00 AM	7.10	3.30
Fri.	2	1.40	4.00	7.10	3.30
Sat.	3	2.40	4.00	7.10	3.30
Sun.	4	No L.	No L.	7.10	3.30
Mon.	5	No L. FM	No L.	7.10	3.30
Tue.	6	No L.	No L.	7.10	3.45
Wed.	7	7.40 PM	9.10 PM	7.10	3.45
Thu.	8	7.40	9.30	7.10	3.45
Fri.	9	7.40	9.50	7.10	3.45
Sat.	10	7.40	10.10	7.10	3.45
Sun.	11	7.30	10.30	7.10	3.45
Mon.	12	7.30	11.00	7.10	3.45
Tue.	13	7.30 LQ	11.30	6.55	4.00
Wed.	14	7.30	12.10 AM	6.55	4.00
Thu.	15	7.30	1.00	6.55	4.00
Fri.	16	7.30	2.10	6.55	4.00
Sat.	17	7.30	4.20	6.55	4.00
Sun.	18	7.20	4.20	6.55	4.00
Mon.	19	7.20	4.20	6.55	4.00
Tue.	20	7.20 NM	4.20	6.45	4.10
Wed.	21	7.20	4.20	6.45	4.10
Thu.	22	7.20	4.20	6.45	4.10
Fri.	23	7.20	4.20	6.45	4.10
Sat.	24	7.20	4.20	6.45	4.10
Sun.	25	8.20	4.20	6.45	4.10
Mon.	26	9.00 FQ	4.20	6.45	4.10
Tue.	27	9.50	4.20	6.30	4.20
Wed.	28	10.40	4.20	6.30	4.20
Thu.	29	11.30	4.20	6.30	4.20
Fri.	30	12.40 AM	4.20	6.30	4.20
Sat.	31	1.40	4.20	6.30	4.20

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45

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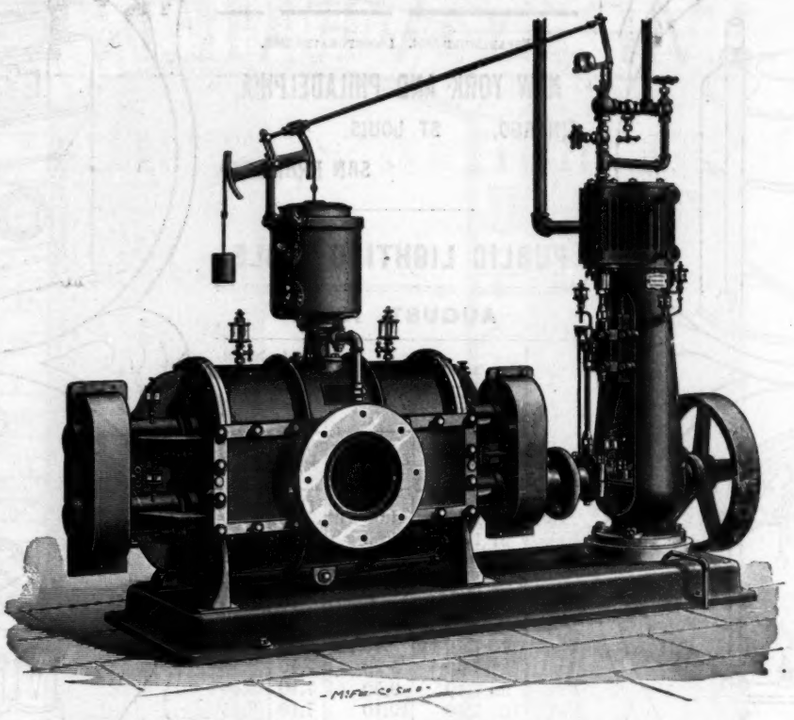

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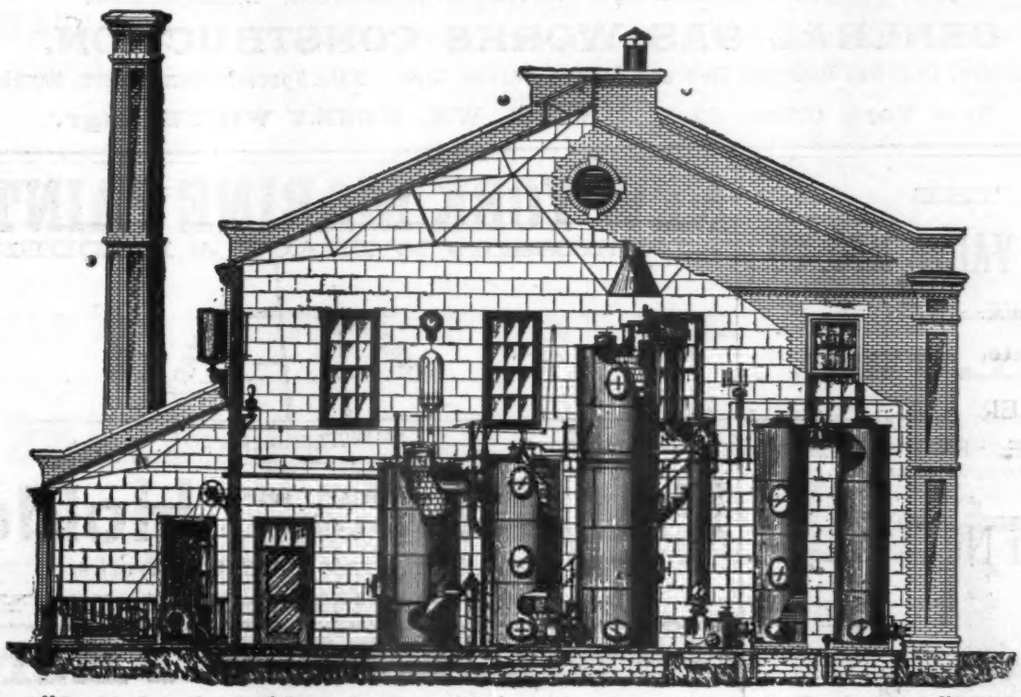

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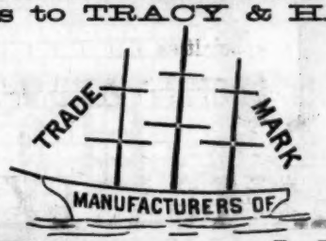

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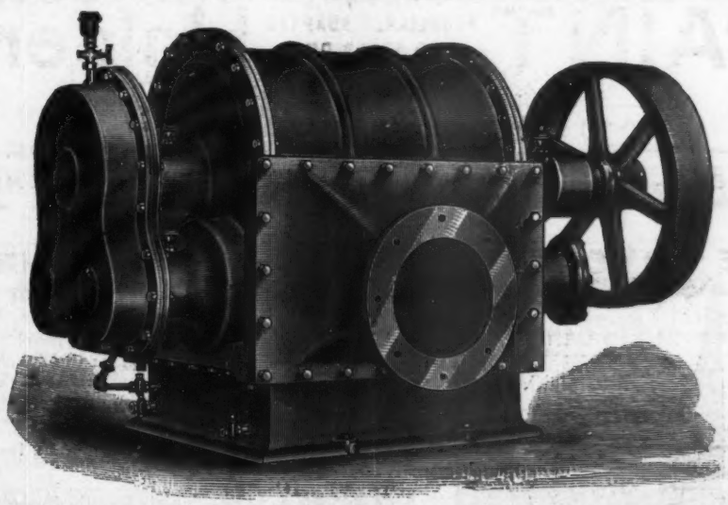

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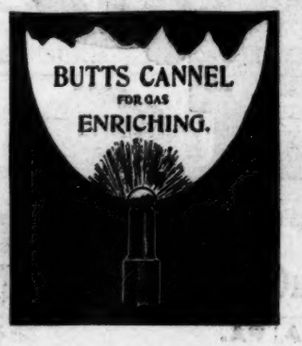

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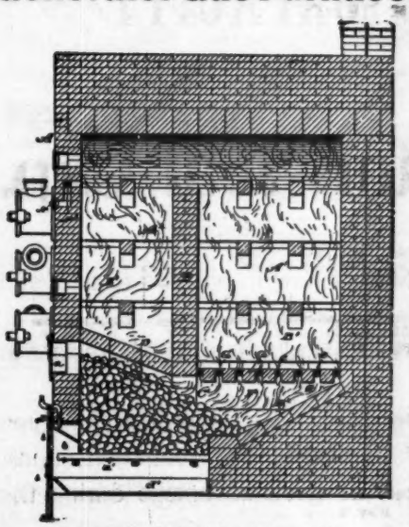

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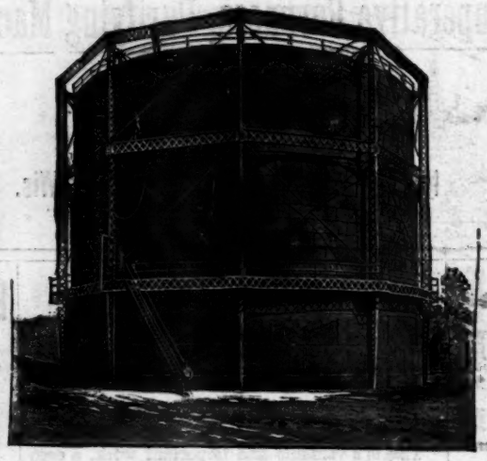

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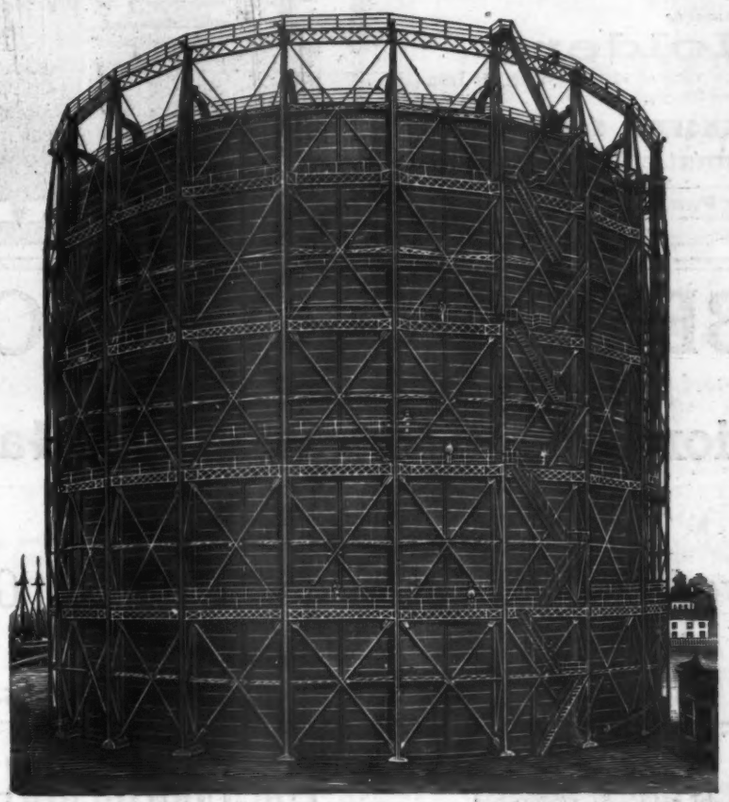

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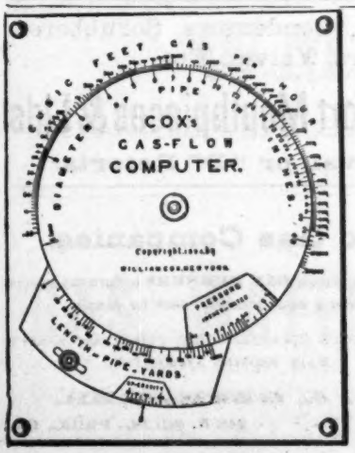

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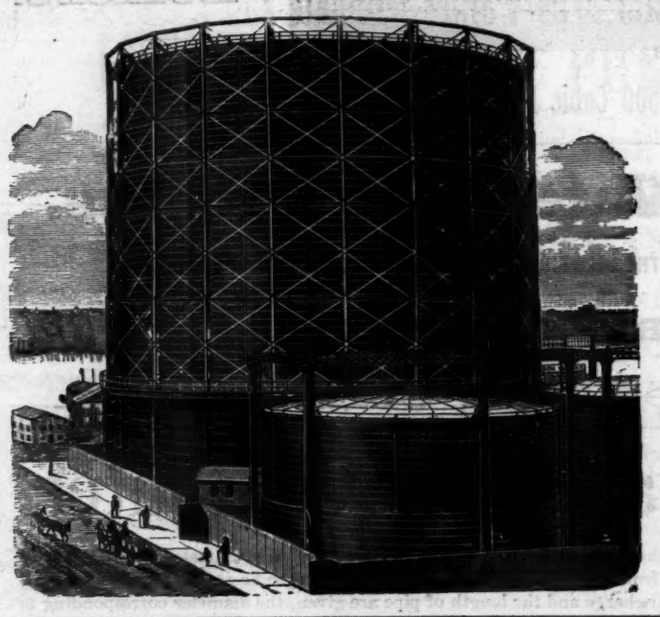

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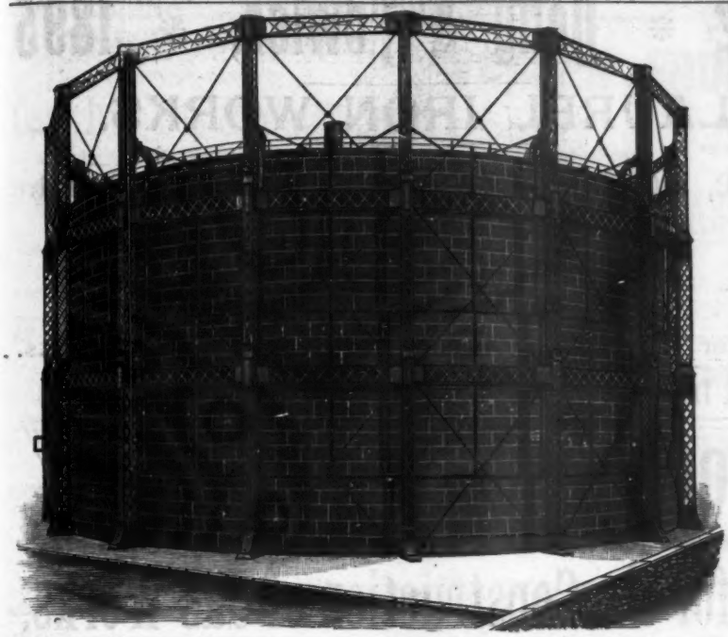

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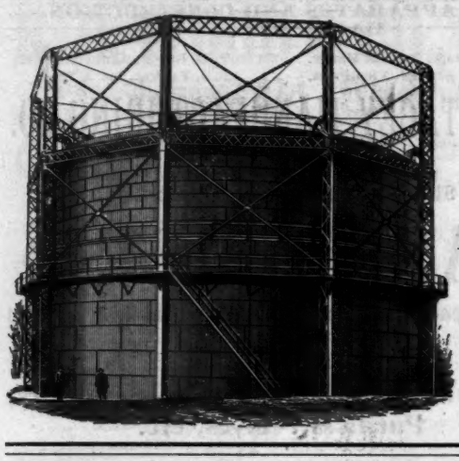

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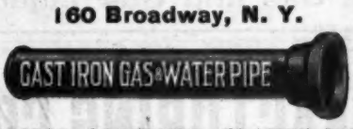

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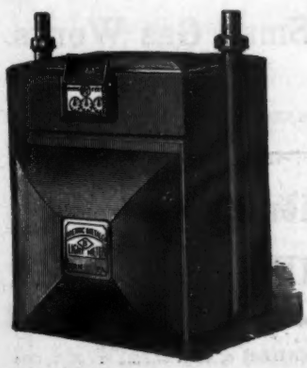

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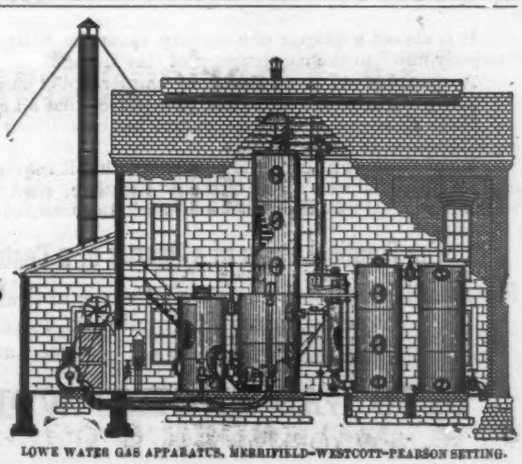

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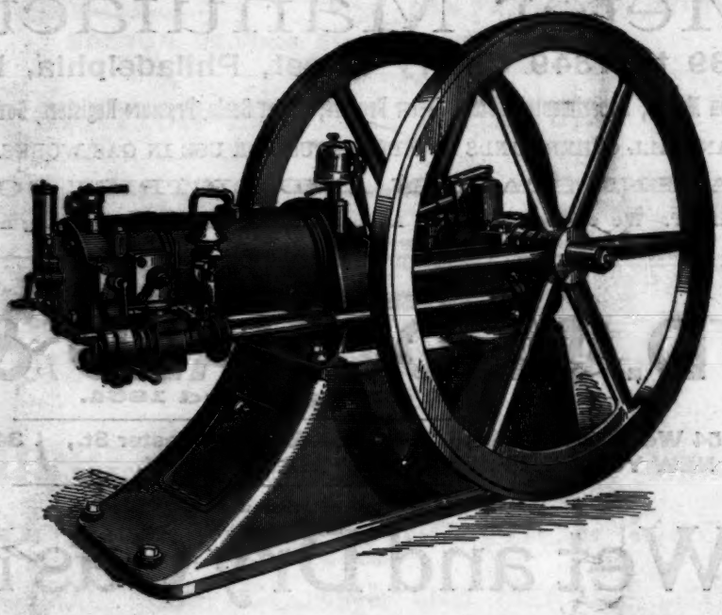

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